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National Dioxin Study Tier 4 Combustion Sources: Final Test Report Site 5, Black Liquor Boiler BLB-B

Radian Corp., Research Triangle Park, NC

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16. ABSTRACT

This report summarizes the results of a dioxin/furan emissions test of a black liquor recovery boiler equipped with a dry-bottom electrostatic precipitator for particulate emissions control. Black liquor recovery boilers are used at Kraft pulp mills to produce process steam and to reclaim inorganic chemicals from spent wood pulping liquors. This test is the fifth in a series of several dioxin/furan emissions tests being conducted under Tier 4 of the National Dioxin Study. The primary objective of Tier 4 is to determine if various combustion sources are found to emit dioxin or furan, the secondary objective of Tier 4 is to quantify these emissions.

Black liquor recovery boilers are one of 8 combustion source categories that have been tested in the Tier 4 program. After an initial information screening and one-day pre-survey visit, this site (BLB-B) was selected partially because of the higher chloride content of the black liquor (3.5 wt.% dry) compared to other black liquor recovery boiler sites surveyed in the Tier 4 study (approx. 0.2 to 1.0 wt%, dry).

Data presented in the report include dioxin (tetra through octa homologue + 2378 TCDD) and furan (tetra through octa homologue + 2378 TCDF) results for stack samples. In addition, process data collected during sampling are also presented.

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NATIONAL DIOXIN STUDY
TIER 4 — COMBUSTION SOURCES

Final Test Report — Site 5
Black Liquor Boiler BLB — B

By

Michael A. Palazzolo
Winton E. Kelly
Donna Holder

Radian Corporation
Research Triangle Park, North Carolina 27709

Contract Number: 68-03-3148

Donald Oberacker, Project Officer
Hazardous Waste Engineering Research Laboratory
U.S. Environmental Protection Agency
Cincinnati, Ohio 45268

U.S. Environmental Protection Agency
Office Of Air And Radiation
Office Of Air Quality Planning And Standards
Research Triangle Park, North Carolina 27711

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FOREWORD

This report is the result of a cooperative effort between the Office of Research and Development's Hazardous Waste Engineering Research Laboratory (HWERL) and the Office of Air Quality Planning and Standard's Monitoring and Data Analysis Division (MDAD). The overall management of Tier 4 of the National Dioxin Study was the responsibility of MDAD. In addition, MDAD provided technical guidance for the source test covered by this report. HWERL was directly responsible for the management and technical direction of the source test.

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1.0 INTRODUCTION

This report summarizes the results of a dioxin/furan[a] emissions test of a black liquor recovery boiler equipped with a dry-bottom electrostatic precipitator for particulate emissions control. Black liquor recovery boilers are used at Kraft pulp mills to produce process steam and to reclaim inorganic chemicals from spent wood pulping liquors. This test is the fifth in a series of several dioxin/furan emissions tests being conducted under Tier 4 of the National Dioxin Study. The primary objective of Tier 4 is to determine if various combustion processes are sources of dioxin and/or furan emissions. If any of the combustion sources are found to emit dioxin or furan, the secondary objective of Tier 4 is to quantify these emissions.

Black liquor recovery boilers are one of 8 combustion source categories that have been tested in the Tier 4 program. After an initial information screening and one-day pre-survey visit, this site (BLB-B) was selected partially because of the higher chloride content of the black liquor (3.5 wt. %, dry) compared to other black liquor recovery boiler sites surveyed in the Tier 4 study (approximately 0.2 to 1.0 wt %, dry). However, the Site BLB-B chloride content of the black liquor was determined to be 0.53 wt%, dry, during the field testing. Also, the weak black liquor concentrating evaporators use direct contact of the hot boiler combustion gases with the weak black liquor, which is a common practice for black liquor boilers installed prior to the early 1970's. The other two black liquor boilers tested in the Tier 4 study (i.e., BLB-A and BLB-C do not use direct contact evaporation).

This test report is organized as follows. A summary of test results and conclusions is provided in Section 2.0, followed by a detailed process description in Section 3.0. The source sampling and analysis plan is outlined in Section 4.0, and the dioxin test data are presented in Section 5.0. Sections 6.0 through 9.0 present various testing details. These include descriptions of the sampling locations and procedures (Section 6.0, description of the analytical procedures (Section 7.0), and a summary of the quality assurance/quality control results (Section 8.0). The appendices contain data generated during the field sampling and analytical activities.

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[a] The term "dioxin/furan" as used in this report refers to the polychlorinated dibenzo-p-dioxin and dibenzofuran isomers with four or more chlorine atoms.

2.0 SUMMARY

The host plant (Site BLB-B) is a Kraft pulp mill that produces pulp and paper products. Black liquor recovery boiler BLB-B combusts strong black liquor from the pulping process and recovers the inorganic chemicals used to produce pulp from wood chips. Particulate emissions from black liquor boiler BLB-B are controlled by a dry bottom electrostatic precipitator. A simplified process flow diagram of the system is shown in Figure 2-1.

2.1 TEST DESCRIPTION

The gaseous, liquid, and solid sampling performed during the test program is summarized in Table 2-1. Sampling for dioxin/ furan was performed simultaneously at the electrostatic precipitator outlet exhaust stack and electrostatic precipitator inlet location (i.e., black liquor boiler outlet) in each of a series of three test runs conducted on February 26 through 28, 1984. The dioxin/furan sampling followed the October 1984 draft of the Modified Method 5 (MM5) procedure recommended by the American Society of Mechanical Engineers (ASME) for measuring emissions of chlorinated organic compounds. This protocol was strictly followed for Site BLB-B except for the modifications discussed in Section 6.1.2.1 (solvent change and condenser orientation). MM5 train components and train rinses were analyzed for dioxins and furans by EMSL-RTP and ECL-Bay St. Louis, two of three EPA laboratories collectively referred to as Troika. The dioxin/furan analysis quantified 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) and the tetra- through octa- dioxin/furan homoloques present in the samples.

Dioxin/furan precursor and TOX analyses were performed by Radian on samples of the concentrated black liquor fed to the boiler. The specific dioxin precursors analyzed for were chlorophenols, chlorobenzenes, and polychlorinated biphenyls. Total chlorine analyses were performed by RTI on concentrated liquor samples. Samples of the black liquor circuit intermediates (white liquor and weak black liquor) and the major chlorine inputs to the system (R2 ClO_2 plant neutralized spent acid, R3 ClO_2 plant byproduct saltcake, and process makeup water) were collected and analyzed by Radian for total chlorine.

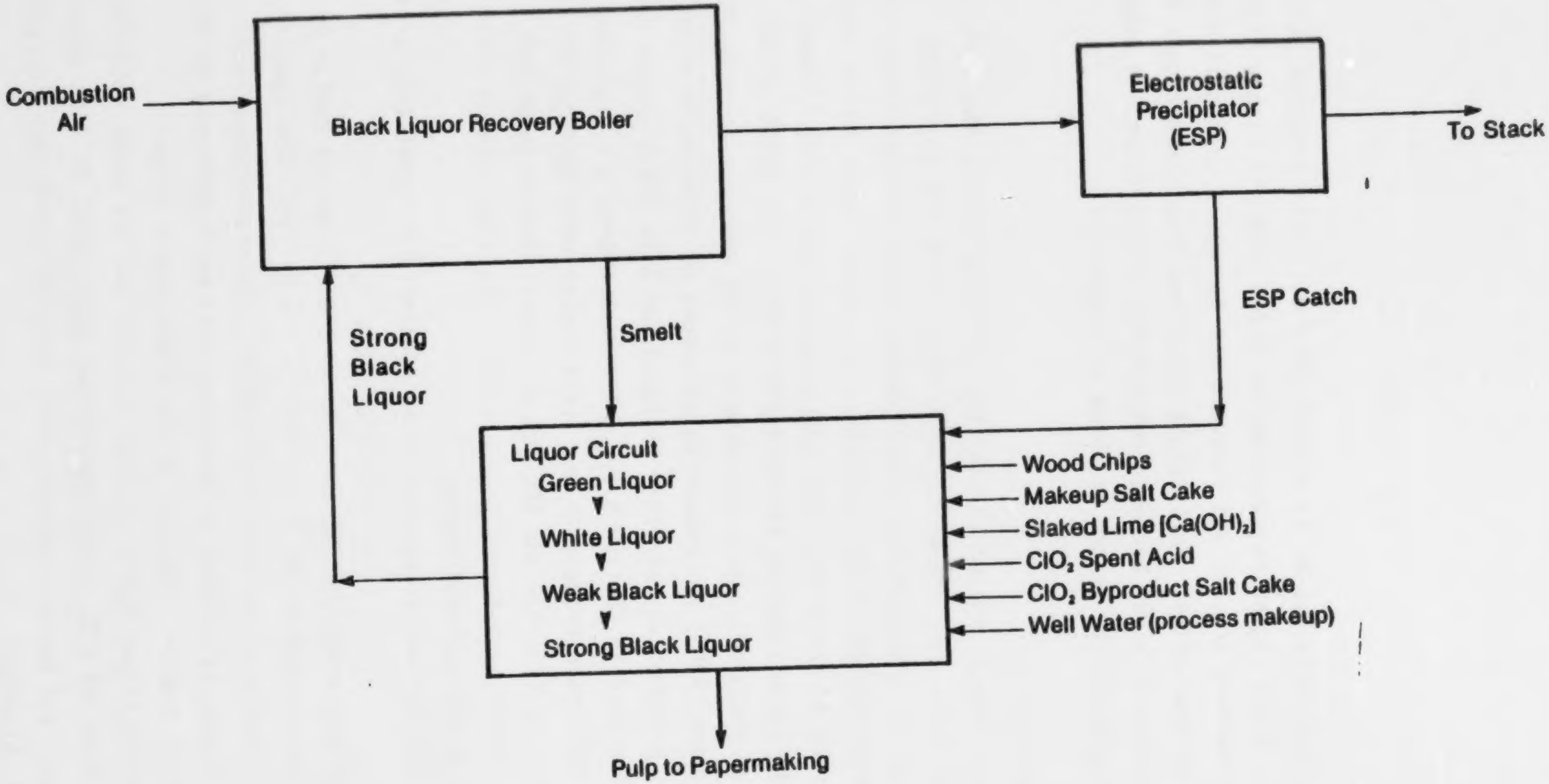


Figure 2-1. Simplified Flow Diagram of Black Liquor Recovery Boiler BLB - B

TABLE 2-1. SOURCE SAMPLING AND ANALYSIS OVERVIEW FOR SITE BLB-B

Item	Item Description
1. Number of test runs	- Three identical test runs (Runs 1, 2, 3).
2. Gaseous sampling	- MM5 sampling at black liquor boiler outlet and ESP outlet exhaust stack (Runs 1, 2, 3). Dioxin analysis. - EPA Reference Methods 2 and 4 at black liquor boiler outlet and ESP outlet exhaust stack (Runs 1, 2, 3). Gas velocity and moisture. - Integrated bag sampling at black liquor boiler outlet and ESP outlet exhaust stack (Runs 1, 2, 3). CO_2, O_2, N_2, analysis for molecular weight determination. - HCl sampling at ESP outlet exhaust stack (Runs 1, 2, 3). - Continuous monitoring of CO, CO_2, O_2, NO_x, SO_2, total hydrocarbons at black liquor boiler outlet (Runs 1, 2, 3).
3. Liquid sampling	- Strong black liquor sampling (Runs 1, 2, 3). Dioxin analysis, dioxin precursor analysis, total chlorine analysis. - White liquor sampling (Runs 1, 2, 3). Total chlorine analysis. - Weak black liquor sampling (Runs 1, 2, 3). Total chlorine analysis. - ClO_2 system waste acid sampling. (Runs 1,2,3). Total chlorine analysis. - Well water sampling (Runs 1, 2, 3). Total chlorine analysis.
4. Solids sampling	- Soil sampling[a] (one composite sample from 10 locations). Potential dioxin analysis. - ClO_2 system byproduct salt cake sampling. (Runs 1, 2, 3). Total chlorine analysis.

[a] Sample(s) to be analyzed pending evaluation of the dioxin/furan emission data from the MM5 sampling train.

The total chlorine analyses for these streams were performed to provide information on the major chlorine inputs to the black liquor circuit (see Table 3-1).

Continuous emission monitoring (CEM) was performed by Radian at the black liquor boiler outlet for CO, CO_2, NO_x, SO_2, total hydrocarbons (THC), and O_2. The continuous monitoring data will be used in conjunction with the process data to relate dioxin emissions to combustion conditions.

A single set of soil samples was collected by Radian and may be analyzed for dioxin by Troika. The soil sample results would provide information on the dioxin content of soils near the plant.

2.2 SUMMARY OF RESULTS

Figure 2-2 summarizes the data obtained at Site BLB-B during the Tier 4 test program. The black liquor boiler and electrostatic precipitator (ESP) were operated under conditions representative of normal operation during the sampling periods. Detectable quantities were found for roughly two-thirds of all dioxin and furan species analyzed for in the stack gas emissions.

2.2.1 ESP Inlet Data

As shown in Table 2-2, average as-measured stack gas concentrations of 2378 TCDD, total PCDD, and total PCDF were not detected, 15.1, and .93 ng/dscm, respectively. This corresponded to hourly mass emission rates of .004 g/hr total PCDD, and .0002 g/hr total PCDF. Emissions of 2378 TCDD, other TCDD, and Penta-CDD were not detected for any of the runs. The octa-CDD homologue was significantly more prevalent than the hexa- and hepta-chlorinated dioxins.

2.2.2 ESP Outlet Data

As shown in Table 2-3, average as-measured stack gas concentrations of 2378 TCDD, total PCDD, and total PCDF were not detected, 1.02, and .60 ng/dscm, respectively. This-corresponded to hourly mass emission rates of .0002 g/hr total PCDD, and .0001 g/hr total PCDF. Emissions of 2378 TCDD, other TCDD, and penta-CDD were non-detectable among runs. The octa-CDD homologue was significantly more prevalent than the hexa- and

Black Liquor Boiler Operating Data Ⓘ

Boiler Load (1,000 lb/hr of steam at 900 psi, 820^{0}F): 343.4
Black Liquor Solids Flow (1,000 lb/hr): 125.2
Black Liquor Solids (wt.%): 70.3
Black Liquor Feed Temperature (^{0}F): 259

Continuous Monitoring Data Ⓒ

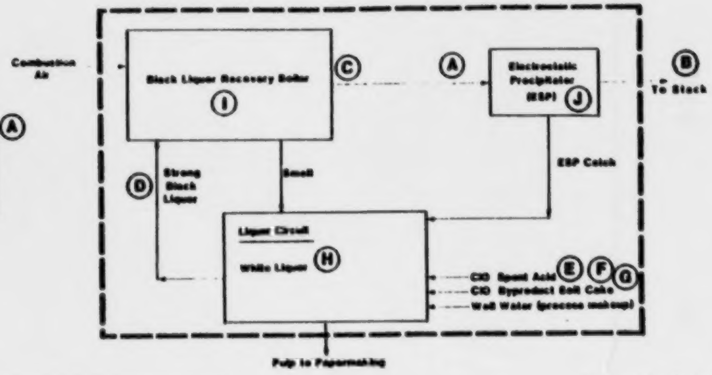
O_2	12.2 % Vol
CO_2	17.4 % Vol
CO	10,900 ppmv
THC	57.7 ppmv (C_3)
SO_2	830 ppmv
NO_x	42.6 ppmv

Electrostatic Precipitator Operating Data Ⓙ

Power Consumption (KW)
North Compartment: 6.5
South Compartment: 11.8
Outlet Temperature (^{0}F): 328

Inlet Flue Gas Parameter Data Ⓐ

Flow Rate: 3,600 dscmm
Temperature: 164^{0}C
Moisture: 32.4 % Vol



Outlet Flue Gas Parameter Data Ⓑ

Flow Rate: 3,800 dscmm
Temperature: 157^{0}C
Moisture: 32.0 % Vol

Process Samples Total Chloride Data ⒺⒻⒼⒽ

Sample Type	Total Chloride (ug/g as Cl^-)
Neutralized Spent Acid	805
By-Product Salt Cake	1,200
White Liquor	6,150
Make-Up Water	230

Feed Precursor Data Ⓓ

Strong Black Liquor
Chlorinated Benzenes - Not detected
Chlorinated Byphenyls - Not detected
Chlorinated Phenols - Trace levels detected of Pentachlorophenol
Total Organic Halides - Not detected
Total Chlorine - .5%, dry basis

Chloride Emission Data Ⓑ

Emissions Type	Concentration (mg/dscm)	Emission Rate (mg/hr)	Emission Factor (ug/Kg)
Front Half	1.91	400,000	7.05
Back Half	0.58	130,000	2.28
Train Total	2.10	440,000	7.73

ESP Inlet Dioxin/Furan Emissions Data Ⓐ

Species	Concentration (ng/dscm)	Emission Rate (ug/hr)	Emission Factor (ug/Kg)
2378 TCDD	ND	ND	ND
Total PCDD	15.1	3383	.06
Total PCDF	.93	209	.004

ND = not detected
Note: Emission factors shown are based on dry solids feed rate to the recovery boiler. Concentrations shown are at as-measured oxygen concentrations.

Outlet Dioxin/Furan Emissions Data Ⓑ

Species	Concentration (ng/dscm)	Emission Rate (ug/hr)	Emission Factor (ug/Kg)
2378 TCDD	ND	ND	0
Total PCDD	1.02	230	.004
Total PCDF	.60	136	.002

ND = not detected
Note: Emission factors shown are based on dry solids feed rate to the recovery boiler. Concentrations shown are at as-measured oxygen concentrations.

Figure 2-2. Data Summary for Site BLB - B

TABLE 2-2. SUMMARY OF MEAN DIOXIN/FURAN EMISSIONS DATA FOR SITE BLB-B (ESP INLET)

Parameter	2378 TCDD	Total PCDD	Total PCDF
Emissions Concentration (ng/dscm)			
As Measured	ND	15.1	.93
Corrected to 3% O_2	ND	17.1	1.07
Emissions Rate (ug/hr)	ND	3383	209

ND = not detected.

TABLE 2-3. SUMMARY OF MEAN DIOXIN/FURAN EMISSIONS DATA FOR SITE BLB-B (ESP OUTLET)

Parameter	2378 TCDD	Total PCDD	Total PCDF
Emissions Concentration (ng/dscm)			
As-Measured	ND	1.02	.60
Corrected to 3% O_2	ND	1.19	.71
Emissions Rate (ug/hr)	ND	230	136

ND = not detected.

hepta-chlorinated dioxins. Total furan emissions were fairly evenly distributed with the exception of the penta-chlorinated furan homologue which was consistently non-detectable among runs. Table 2-4 compares dioxin/furan emission before and after the ESP.

2.2.3 ESP Dioxin/Furan Emissions Reduction

As shown in Table 2-4, the total PCDD concentration in the stack gas was reduced by 93 percent across the ESP. The total PCDF concentration decreased by 35 percent.

Figure 2-2 summarizes the additional data obtained at Site BLB-B. Strong black liquor feed was analyzed for chlorinated benzenes, chlorinated biphenyls, and chlorinated phenols, but only trace levels of pentachlorophenol were found. There were no total organic halides (TOX) found in the strong black liquor. The boiler was operated similarly during the individual test runs with the exception of a slightly lower flue gas oxygen content for Run 02 compared with Runs 01 and 03. There were no process upsets during any of the runs that resulted in sampling interruptions. Boiler load during the test periods averaged 343.4 (1,000 lb/hr of steam at 900 psi, 820^{o}F), and the black liquor feed temperature to the boiler averaged 259^{o}F. The ESP power consumption in the north and south compartments averaged 6.5 and 11.8 KW, respectively. The average ESP outlet temperature was 328^{o}F.

Average flue gas concentrations measured in the exhaust stack by the Radian continuous emission monitoring system were: O_2, 12.2 vol.%; CO_2, 17.4 vol.%; CO, 10,900 ppmv; THC, 57.7 ppmv (C_3); SO_2, 830 ppmv; and NO_x, 42.6 ppmv, all corrected to 3% O_2, on a dry basis except for THC. Total chloride emissions concentrations measured using the HCl train at the ESP outlet exhaust stack were 2.1 ng/dscm (as-measured), and the total HCl emission rate was .44 Kg/hr. The front half of the HCl train (i.e., probe rinse and filter) accounted for roughly 90 percent of the total chloride emissions and the back half (i.e., impingers and back half rinse) accounted for the remaining 10 percent. The total chloride content measured for the various process samples was neutralized spent acid, 805 ug/g; by-product salt cake, 1,200 ug/g; white liquor, 6,150 ug/g; and make-up water, 230 ug/g, expressed as Cl^-.

TABLE 2-4. ESP INLET/OUTLET DIOXIN/FURAN EMISSIONS DATA SUMMARY

Parameter	Inlet	Outlet	% Emissions Reduction
Emission Concentration, As-measured (ng/dscm)			
2378 TCDD	ND	ND	0
Total PCDD	15.1	1.02	93
Total PCDF	.93	.60	36
Emission Rate (ug/hr)			
2378 TCDD	ND	ND	0
Total PCDD	3383	230	93
Total PCDF	209	136	35

ND = Not Detected

The composite soil sample obtained at Site BLB-B is currently being analyzed by a non-Tier 4 EPA group for dioxin/furan content.

3.0 PROCESS DESCRIPTION

This section describes the host site and the black liquor recovery boiler/electrostatic precipitator system tested. Data summarizing the operation of the boiler and the precipitator during the test periods are presented in Section 5.0.

3.1 FACILITY DESCRIPTION

The host plant, (Site BLB-B), is a Kraft pulp mill with a rated capacity of 1725 Mg/day (1900 TPD) of air-dried pulp. The plant maintains two black liquor recovery boilers with rated capacities of 725 Mg/day (800 TPD) and 1000 MG/day (1100 TPD) of air-dried, unbleached pulp. The dioxin/furan emissions tests were conducted on the 725 Mg/day (800 TPD) boiler.

Both soft and hard woods (pine and gum) are processed at Site BLB-B. Wood and wood chips are transported to the plant by truck. None of the wood processed in the pulping circuit has been stored in salt water or, to the best knowledge of plant personnel, treated with pentachlorophenol (PCP). Approximately 120 digester batches per day are processed in the 17 digesters at the pulping plant. Each batch consists of 64 Mg (70 tons) of wood chips, 34 to 54 cubic meters (1200 to 1900 cuft) of white liquor, and a small amount of weak black liquor.

The contents of the finished digester batches are sent to a "blow tank" for intermittent storage and then to a countercurrent "brown stock washer" system. Pulp is separated from the rest of the finished digestor batch in the brown stock washers. Dirty water from the brown stock washers (i.e., weak black liquor) is sent to an evaporator system for solids concentration prior to being fired in the black liquor boiler.

Cleaned pulp from the brown stock washer is bleached, pressed, and spooled for off-site production into a variety of paper products. Bleaching is performed using chlorine dioxide (ClO_2), which is produced on-site using the R2 and R3 processes. Neutralized spent acid (predominately sodium sulfate) from the R2 process is fed to the black liquor circuit at the rate of 38 cubic meters (1340 cu ft) per day. Approximately 36 Mg/day (40 TPD) of by-product salt cake from the R3 process is also fed to the black liquor circuit. These two by-product or waste streams provide make-up sodium and sulfur for the pulping process.

3.2 BLACK LIQUOR RECOVERY BOILER DESCRIPTION

Black liquor recovery boiler BLB-B is a Combustion Engineering recovery boiler with a rated capacity of 725 Mg/day (800 TPD) unbleached pulp. The boiler, which was installed in 1962, is typically base loaded and operates at a steady black liquor firing rate.

The solids content of the concentrated black liquor fired in Boiler BLB-B is approximately 70 percent by weight. Concentration of the weak black liquor produced by the brown stock washers is accomplished using a four-stage multiple effect evaporator system and cascade direct contact evaporators. Particulate matter from combustion of the black liquor is collected dry in an electrostatic precipatator. The dry precipitator catch and fresh make-up salt cake are mixed with the strong black liquor before the liquor is fired in the boiler.

The chloride content of the concentrated black liquor fed to boiler BLB-B is typically .53% on a dry basis. The majority of chlorine entering the black liquor circuit comes from one of three sources: the neutralized spent acid (R2), the by-product saltcake (R3), and well water used for process make-up. Chlorine contents and flow rates for these three streams and for the weak black liquor, strong black liquor and white liquor are shown in Table 3-1. Other potential sources of chlorine entering the black liquor circuit include small amounts of calcined lime (CaO) used in converting green liquor to white liquor, fresh makeup saltcake ($Na_2 SO_4$) added to the strong black liquor, and wood chips fed to the process.

Concentrated black liquor is sprayed into the combustion zone of boiler BLB-B at a temperature of approximately 127^{0}C (260^{0}F) using four oscillating "guns". Primary and secondary combustion air are suppled to the boiler by forced draft fans. The primary: secondary air ratio is approximately 0.8:1. The combustion air supply is computer controlled using flue gas oxygen monitoring and black liquor feed rate monitoring. Oxygen is continuously monitored at the economizer section of the boiler.

3.3 ELECTROSTATIC PRECIPITATOR DESCRIPTION

Exhaust gases from black liquor recovery boiler BLB-B pass through a two-chamber Flakt electrostatic precipitator (ESP) for particulate removal.

TABLE 3-1. CHLORINE CONTENTS AND FLOW RATES FOR VARIOUS PULP MILL PROCESS STREAMS AT SITE 05

Process Stream or Material	Process Flow Rate	Total Chlorine (by weight)	Chlorine Contribution (g Chlorine/Mg of solids burned)[a]	Other Information
Neutralized spent acid	1.6 m^3/hr (417 gallon/hr)	805 ppm	9.67	Predominately sodium sulfate
By-product salt cake	1520 Kg/hr (3340 lb/hr)	1200 ppm	13.9	Predominately sodium sulfate
White liquor	236 m^3/hr (62,500 gallon/hr)	6150 ppm	NA[b]	Sodium sulfide/sodium hydroxide
Weak black liquor	834 m^3/hr (220,500 gallon/hr)	0.5%[c]	NA	14.5% solids by weight
Strong black liquor[d]	140 m^3/hr (37,080 gallon/hr)	0.5%[e]	NA	70% solids by weight Heat value 13.9 KJ/g (6000 Btu/lb)
Make-up water	520 m^3/hr (137,500 gallon/hr)	230 ppm	911	Well water

[a] Chlorine contribution based on weight of dry black liquor solids burned in both recovery boilers.

[b] NA - not applicable.

[c] Wet basis.

[d] Includes both recovery boilers.

[e] Dry basis.

Particulate matter is removed from the ESP hopper by drag and screw type conveyors. Particulate matter is recycled directly back into the pulping liquor circuit (resulting in an inaccessible sampling location). Each chamber of the ESP handles approximately half of the total boiler exhaust gas of 290,000 acfm at 330 F. The ESP has a design specific collection area of 0.4 ft^2/acfm and a design particulate removal efficiency of 99.6 percent.

4.0 TEST DESCRIPTION

This section describes the field sampling, process monitoring, and analytical activities that were performed for test Site BLB-B. The purpose of the section is to provide sufficient descriptive information about the test so that the test results presented in Section 5.0 can be easily understood. Descriptions of the sampling locations and sampling procedures are presented in Section 6.0.

The remainder of this section is divided into three parts. Section 4.1 summarizes field sampling activities, Section 4.2 summarizes process monitoring activities, and Section 4.3 summarizes analytical activities performed during the test program.

4.1 FIELD SAMPLING

Table 4-1 shows the source sampling and analysis matrix for test Site BLB-B. Three dioxin/furan emissions tests (Runs 01, 02, 03) were performed simultaneously at the electrostatic precipitator inlet location and the electrostatic precipitator outlet exhaust stack. These locations are shown as Points D and E on Figure 4-1. Dioxin/furan sampling followed the Modified Method 5 (MM5) sampling protocol developed by the American Society of Mechanical Engineers (ASME) for measuring emissions of chlorinated organic compounds with two minor modifications (see section 6.1.2.1 for details). Testing was performed at the electrostatic precipitator outlet exhaust stack for a period corresponding to 240 minutes of on-line sampling. Testing was performed during the same time period at the electrostatic precipitator inlet location. The on-line sampling period was from 160 to 200 minutes. The recovery boiler flue gas is divided between two identical, parallel direct contact evaporator-ESP systems. Dioxin/furan tests were performed only on the South Inlet Duct. The two ESP inlet ducts were physically separated so that both ducts could not be tested using the same sampling train. Additional personnel and equipment would have been required to sample at both ESP inlet streams. Since the direct contact evaporators contact the same gas stream with the same black liquor stream, and the two ESP sections are identical, the dioxin/furan content should be similar in each ESP inlet stream. In order to

TABLE 4-1. SOURCE SAMPLING AND ANALYSIS MATRIX FOR SITE 05

Sample Location	Sample Type or Parameter	Sampling Method	Analytical Method	Number of Samples or Frequency
1. Electrostatic precipitator outlet exhaust stack (Poing E, Figure 4-1)	Dioxin, furan	Modified EPA Method 5 (MM5)	Gas chromatograph/ mass spectrometer	Three test runs; one per test day
	Volumetric flow	EPA Method 2	S-type pitot	Once per MM5 test run
	Molecular weight	EPA Method 3	Gas chromatography/thermal conductivity detector	Two integrated bag samples per MM5 test run
	Moisture	EPA Method 4	Gravimetric	Once per MM5 test run
	HCl	Modified EPA Method 5 (MM5/HCl)	Ion chromatography	Once per MM5 test run
2. Electrostatic precipitator inlet South Duct (Point D, Figure 4-1)	Dioxin, furan	Modified EPA Method 5	Gas chromatograph/mass spectrometer	Three test runs; one per test day
	Volumetric flow	EPA Method 2	S-type pitot	One per MM5 test run
	Molecular weight	EPA Method 3	Gas chromatography/thermal conductivity detector	Two integrated bag samples per MM5 test run
	Moisture	EPA Method 4	Gravimetric balance	Once per MM5 test run
North Duct	Volumetric flow	EPA Method 2	S-type pitot	One per MM5 test run
3. Recovery Boiler Outlet (Point C, Figure 4-1)	CO/CO_2	In-stack filter probe and heat-traced Teflon sample line	Nondispersive infrared analyzer	Continuously during MM5 test runs
	O_2	Same as CO/CO_2	Paramagnetic analyzer	Continuously during MM5 test runs
	NO_x	Same as CO/CO_2	Chemiluminescent analyzer	Continuously during MM5 test runs
	SO_2	Same as CO/CO_2	Pulsed fluorescence analyzer	Continuously during MM5 test runs
	Total hydrocarbons (THC)	Same as CO/CO_2	Flame ionization analyzer	Continuously during MM5 test runs

TABLE 4-1. SOURCE SAMPLING AND ANALYSIS MATRIX FOR SITE 05 (Continued)

Sample Location	Sample Type or Parameter	Sampling Method	Analytical Method	Number of Samples or Frequency
4. Strong black liquor mix tank	Strong black liquor for dioxin/furan, dioxin/furan precursors, and total chloride analyses	Grab samples	Gas chromatography/mass spectrometer, ion chromatography	Three identical samples of hourly sample composites for each MM5 test run
5. White liquor storage tank	White liquor for total chloride analysis	Tap valve samples	Ion chromatography	One composite of two samples taken during each test run
6. Weak black liquor line leading to concentrators	Weak black liquor for total chloride analysis	Tap valve samples	Ion chromatography	One composite of two samples taken during each test run
7. Spent acid lime from R-2 plant to digestors	Neutralized spent acid for total chloride analysis	Tap valve samples	Ion chromatography	One composite of two samples taken during each test run
8. Byproduct saltcake rotary filter in R3 ClO_2 plant	Byproduct saltcake for total chloride analysis	Grab samples	Ion chromatography	One grab sample taken during each test run
9. North and South wells	Process make-up water (well water) for total chloride analysis	Tap valve samples	Ion chromatography	One composite of two samples taken during each test run
10. Plant property	Soils for dioxin, furan analysis	Grab samples	Gas chromatograph/mass spectrometer	One composite of ten samples taken at various locations

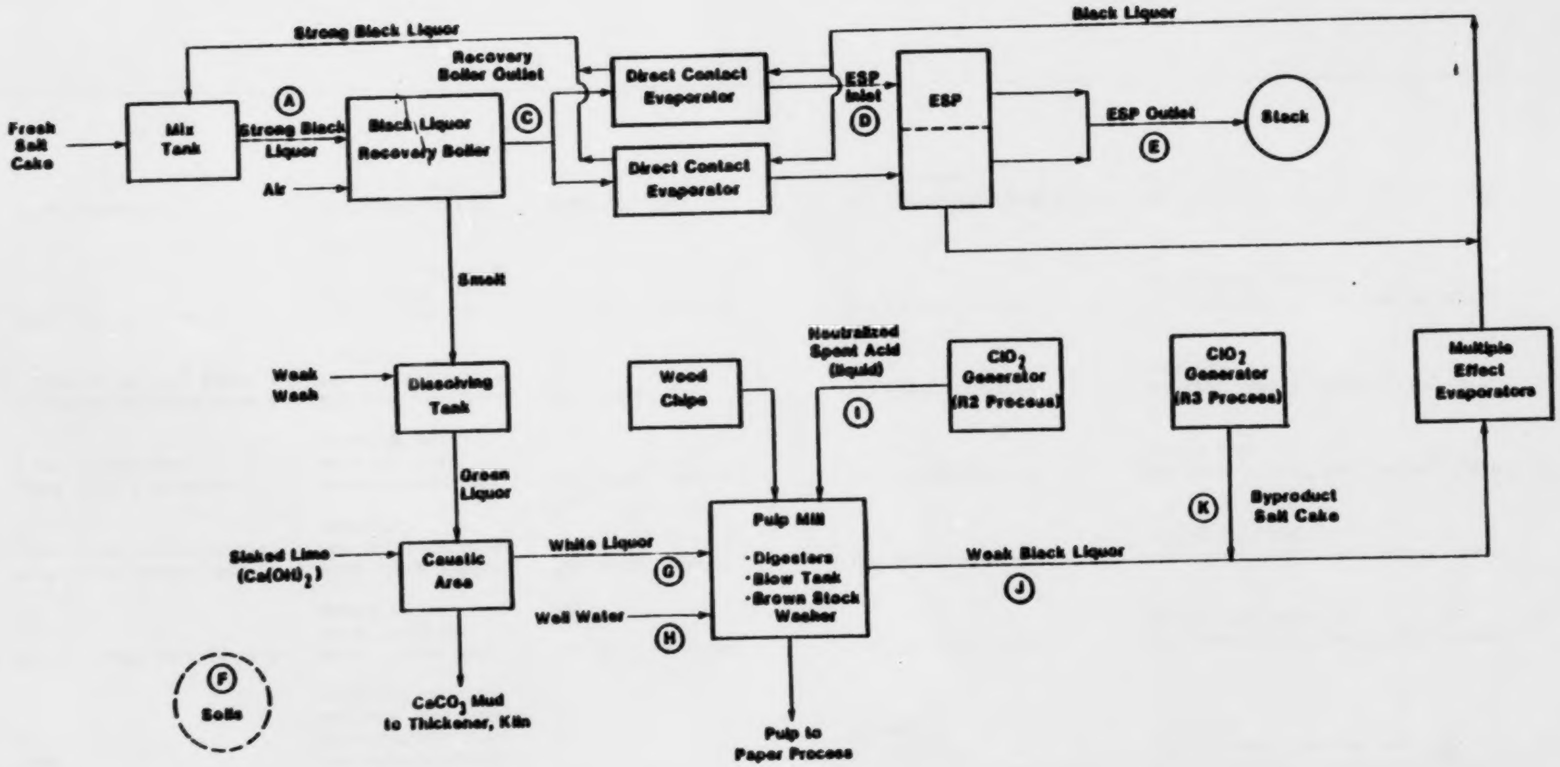


Figure 4-1. Process Flow Diagram and Sample Locations for Site BLB-B.

demonstrate that the parallel direct contact evaporators were operating similarly, the flue gas temperature and gas velocity were measured at the North Inlet Duct during each test run.

Concentrations of HCl in the flue gas were determined for each test day at the electrostatic precipitator outlet exhaust stack using another modification of EPA Method 5. The sampling train was identical to that of Method 5 except that water in the impingers was replaced with 0.1 M KOH. The impinger solution was changed to potassium hydroxide at the suggestion of the National Council for Air and Stream Improvement (NCASI). The substitution of KOH in the impinger was performed in an effort to eliminate sodium chloride (NaCl) interferences in the HCl measurement (to avoid overestimating chloride content).

Continuous emissions monitoring (CEM) of O_2, CO, CO_2, SO_2, NO_x, and total hydrocarbons (THC) was performed during the three MM5 test runs. These data were obtained to assess variations in combustion conditions during the sampling periods. Instantaneous concentration values for each species monitored were recorded every five minutes by the CEM data system.

Six types of process samples were taken during the MM5 test periods: strong black liquor, white liquor, weak black liquor, R2 ClO_2 generator spent acid, well water, and R3 ClO_2 generator by-product saltcake. The strong black liquor samples were taken to characterize dioxin-furan and dioxin/furan precursor contents of the material fed to the boiler. Three identical composites of hourly strong black liquor samples were prepared: one for dioxin/furan analysis by Troika, one for dioxin/furan precursor analysis by Radian/RTP, and one for total chloride analysis by Research Triangle Institute. The white liquor, weak black liquor, well water and ClO_2 generator spent acid and by-product saltcake samples were taken to indicate the major contributors of chloride to the mill liquor circuit. These samples were taken twice during each test day, and a single sample composite for each test run was sent to Radian/Austin for total chloride analysis.

Soil samples were collected from ten locations at the plant site. The ten samples were combined into a single composite, which was held for potential dioxin/furan analysis pending evaluation of the MM5 dioxin/furan emissions data.

4.2 PROCESS DATA COLLECTION

Process data were collected to characterize the operation of the black liquor boiler and electrostatic precipitator during the MM5 test periods. A copy of the daily status report for the recovery boiler system was provided by the host site. This report includes an hourly listing of the recovery furnace operating variables. These variables include black liquor characteristics furnace drafts and air flow furnace and ESP temperatures steam flow, and flue gas and green liquor compositions. Electrostatic precipitator voltage and current data were recorded manually at intermittent times throughout the test period. The process data will be used in Section 5.1 with the CEM data to evaluate and compare combustion conditions during the three MM5 test periods.

4.3 LABORATORY ANALYSES

Laboratory analyses performed on samples from test Site 05 included dioxin/furan analyses, dioxin/furan precursor analyses and total chloride analyses. Samples analyzed for dioxin/furan are discussed in Section 4.3.1 and samples analyzed for dioxin precursors are discussed in Section 4.3.2. Samples analyzed for chloride are discussed in Section 4.3.3.

4.3.1 Dioxin/Furan Analyses

All dioxin/furan analyses for Site SSI-B samples were performed by EMSL-RTP and ECL-Bay St. Louis, two of three EPA laboratories collectively referred to as Troika.

Dioxin/furan analyses were performed by gas chromatography/mass spectroscopy. Specific isomers identified included 2378 TCDD and 2378 TCDF. Other dioxin/furan compounds were quantified in groups according to the number of chlorine atoms per molecule. The tetra-through octa-chlorinated homologues were quantified.

4.3.2 Dioxin/Furan Precursor Analysis

Dioxin/furan precursor analyses of strong black liquor samples were performed by Radian using gas chromatography/mass spectroscopy. The specific dioxin/furan precursors to be analyzed for included chlorophenols, chlorobenzenes, and PCB's. Composite feed samples were also analyzed for total chlorine by Parr Bomb combustion followed by ion chromatography and for total organic halide-by gas chromatography and Hall detector

4.3.3 Total Chloride Analysis

Chloride analysis was performed on the combined probe rinse/filter sample and on the back half-rinse/impinger solution sample for each HCl train (i.e., front half and back half analysis). Chloride analysis only was also performed on the strong black liquor, white liquor, weak black liquor, by-product saltcake, neutralized spent acid, and the make-up water (well-water) by Radian/Austin.

5.0 TEST RESULTS

The results of the Tier 4 dioxin/furan emissions test of black liquor boiler BLB-B are presented in this section. The individual test runs are designated as Runs 1 - 3.

Process data obtained during the test runs are presented in Section 5.1, and continuous monitoring results for O_2, CO, CO_2, NO_x, SO_2, and THC are presented in Section 5.2. The dioxin/furan emissions data are contained in Section 5.3. Results of HCl train sampling at the precipitator outlet and chlorine analysis of various process samples are presented in Section 5.4. Strong black liquor dioxin/furan analysis and dioxin/furan precursor analysis are presented in Section 5.5.

5.1 PROCESS DATA

Process data were obtained to document black liquor boiler and electrostatic precipitator operation during the test runs . The boiler operating data are summarized in Section 5.1.1, and the electrostatic precipitator operating data are summarized in Section 5.1.2.

5.1.1 Black Liquor Boiler Operating Data

Plant-maintained data summarizing the mean operating conditions of black liquor boiler BLB-B during the three MM5 test runs are shown in Table 5-1. Hourly data for boiler load, flue gas oxygen content in the economizer section of the boiler, strong black liquor solids flow, and primary and secondary air flow are shown for each test run in Figures 5-1, 5-2 and 5-3. The data show that the boiler was operated similarly during the individual test runs with the exception of a slightly lower flue gas oxygen content for Run 2 compared to Runs 1 and 3. There were no process upsets during any of the runs that resulted in sampling interruptions.

5.1.2 Electrostatic Precipitator Operating Data

Electrostatic precipitator operating data maintained by the host plant are summarized in Table 5-2 for test runs 1, 2, and 3. The data show similar

TABLE 5-1. MEAN VALUES[a] FOR BOILER OPERATING PARAMETERS DURING DIOXIN TESTING AT SITE 05

Test Run	Black Liquor Solids Flow (1000 lb/hr)	Black Liquor Solids (wt. %)	Boiler Load[b] (1000 lb/hr)	Boiler Oxygen (% by vol.)[c]	Black Liquor Temperature (°F)	Boiler Combustion Air	
						Primary (1000 lb/hr)	Secondary (1000 lb/hr)
Run 1	124.9	70.4	345.5	2.74	259.3	27	35
Run 2	125.4	70.4	336.2	1.76	259.7	27	36
Run 3	125.3	70.1	348.5	2.40	258.1	28	36
Average	125.2	70.3	343.4	2.30	259.0	27	36

[a] Values presented in units used by host plant:
To convert from: lb/hr to kg/hr multiply by: 0.454; psi to KPa multiply by 6.89; °C = (°F - 32)/1.8.

[b] Boiler load in 1000 lb/hr of steam at 900 psi, 820°F.

[c] Percent by volume, wet basis.

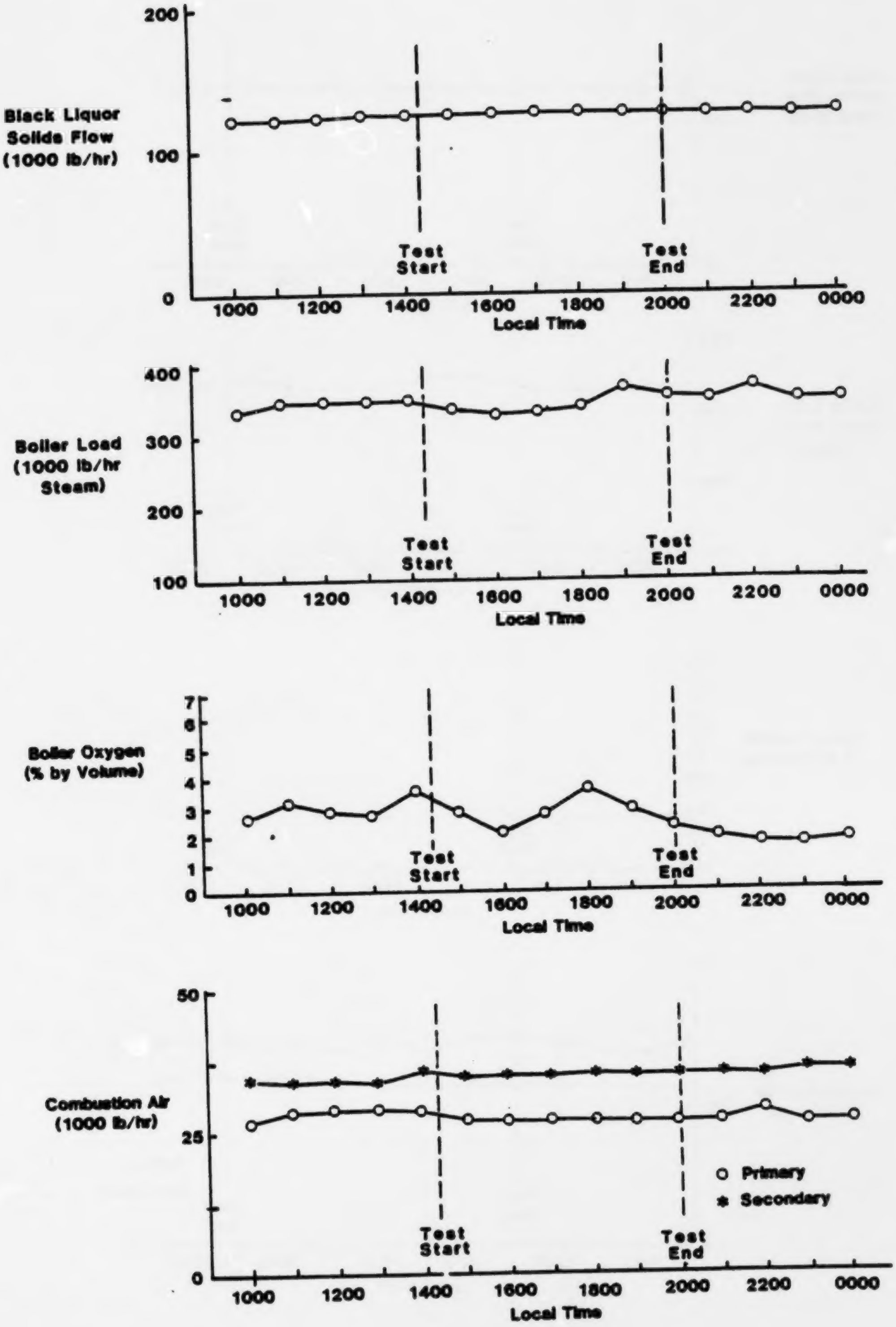


Figure 5-1. Hourly Boiler Operating Data for Run 1.

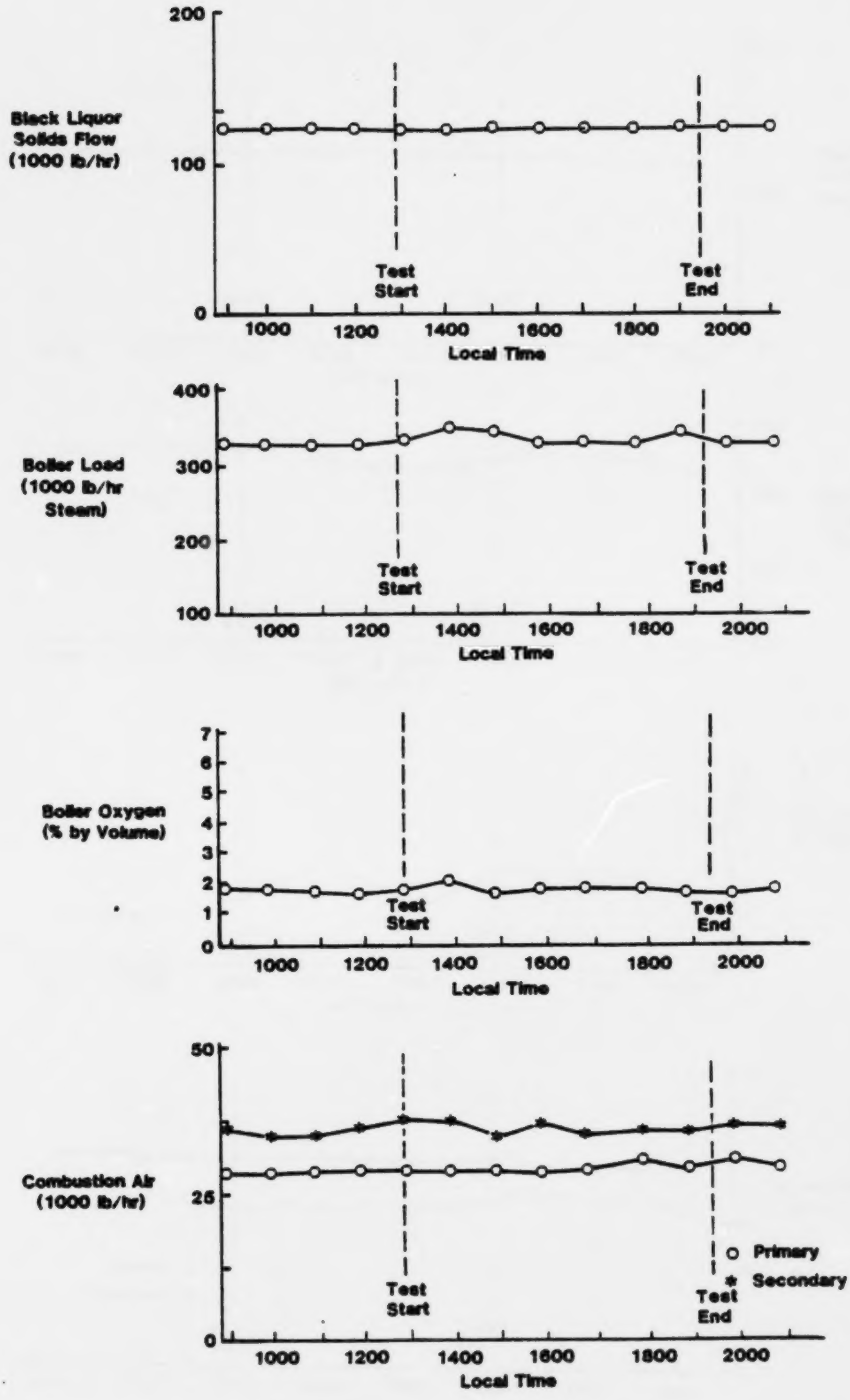


Figure 5-2. Hourly Boiler Operating Data for Run 2.

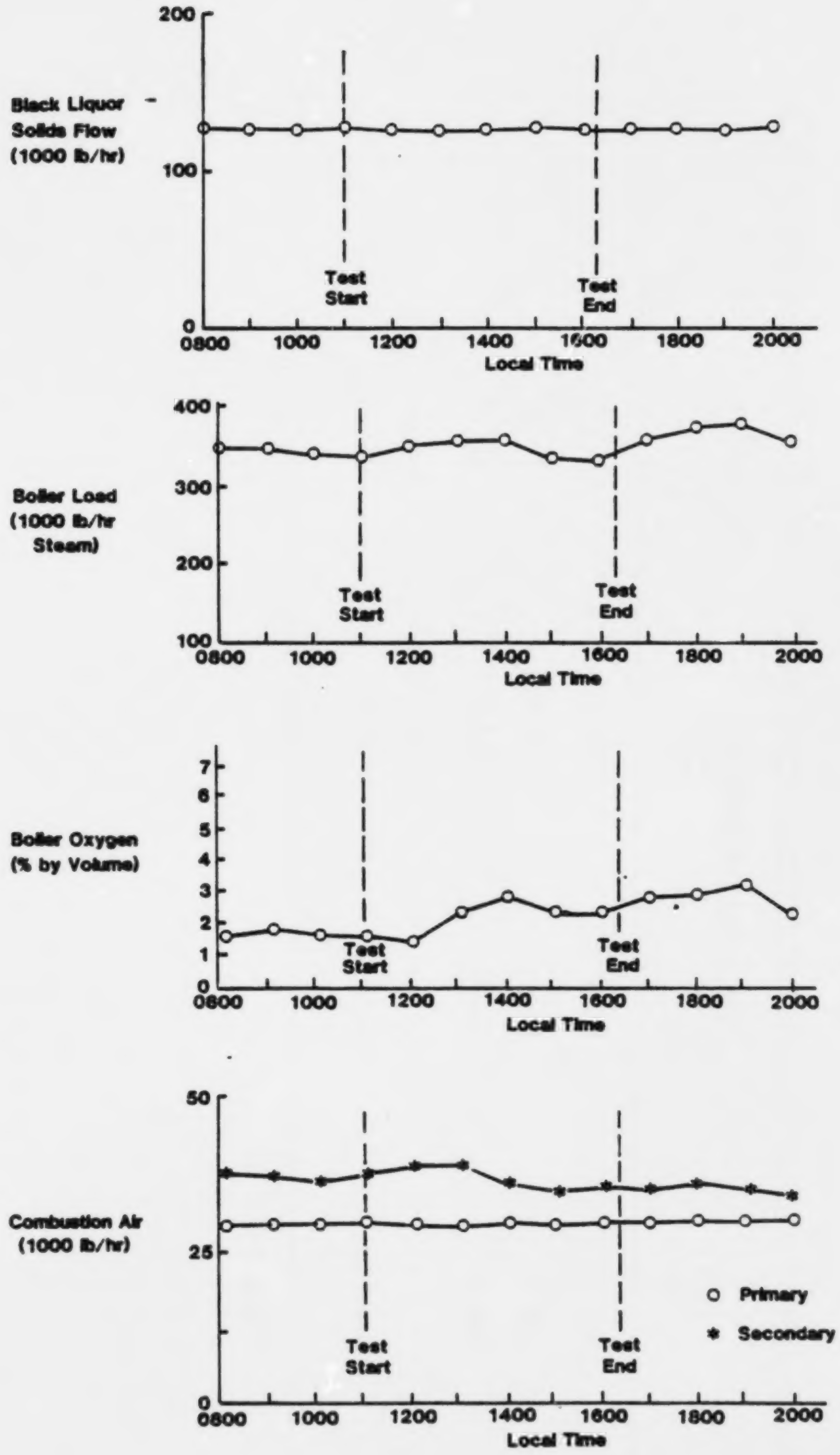


Figure 5-3. Hourly Boiler Operating Data for Run 3.

TABLE 5-2. ESP OPERATING DATA FOR SITE 05

Test Run	ESP Power Consumption North (kW)	 South (kW)	ESP Outlet Temperature[a] (°F)
Run 1	5.75	14.9	327.9
Run 2	6.10	9.4	328.2
Run 3	7.64	11.0	327.4
Average	6.50	11.8	327.8

[a] °C = (°F - 32)/1.8

ESP operation during the three runs, with the exception of some variability in the south ESP compartment power consumption.

5.2 FLUE GAS PARAMETER DATA

Table 5-3 summarizes flue gas temperature, moisture, volumetric flowrate, and oxygen concentration data obtained at Site BLB-B. These parameters were fairly consistent among test runs. The average flue gas temperature and moisture content measured at the ESP inlet and outlet were 164^{0}C, 32.4%, and 157^{0}C, 32.0%, respectively. The average gas flowrates for the ESP inlet and outlet under actual stack temperature and moisture conditions were 8,200 (287,300 ascf) and 8,100 (282,500 ascf) acmm, respectively. The average dry standard flowrate was 3,700 dscmm (129,500 dscfm) for the inlet and 3,800 dscmm (132,100 dscfm) for the outlet. Standard EPA conditions are 20^{0}C (68^{0}F) and 1 atm.

5.3 CONTINUOUS EMISSIONS MONITORING DATA

The continuous emissions monitoring system that was used to measure the combustion products in the black liquor flue gas did not operate in a fully successful manner during this test. A significant difference was observed between the oxygen value reported by the CEM system and the values reported by the plant O_2 analyzer and the Reference Method 3 tests. The average results reported by the three measurements are summarized in Table 5-4. As can be observed, the CEM system reported consistently high results.

The oxygen concentration measured by the Radian CEM system ranged from 10.9 to 13.1 percent by volume. The values reported by the host site instruments (Table 5-1)were about 2.3% by volume. The EPA Method 3 results for samples collected at the ESP Inlet ranged from 3.9 to 5.2 percent. The cause for the difference in results was a leak in the pump in the gas conditioning system that could not be repaired in the field. Because of the leak, the results cannot be used for direct comparison of combustion conditions. However, the oxygen results can be used to normalize the CO, CO_2, NO_x and SO_2 results to the 3% O_2 basis that has been selected for the Tier 4

TABLE 5-3. FLUE GAS PARAMETERS AT SITE BLB-A[a]

Flue Gas Parameter	Run 01 Inlet	Run 01 Outlet	Run 02 Inlet	Run 02 Outlet	Run 03 Inlet	Run 03 Outlet	Average Inlet	Average Outlet
Temperature (^oC)	158.0	158.0	165.0	153.0	168.0	159.0	164.0	157.0
Moisture (Vol %)	32.8	32.0	32.5	33.0	32.0	31.0	32.4	32.0
Volumetric Flowrate								
Actual (acmm)	8000	8000	8300	8000	8400	8200	8200	8100
Dry Standard (dscmm)	3700	3700	3700	3700	3700	3900	3700	3800
Oxygen Content (Vol %)								
EPA Method 3[b]	3.9	5.9	4.7	5.4	5.2	5.3	4.6	5.5
Plant O_2 Analyzer[c]	3.6	NA	2.4	NA	3.2	NA	3.1	NA

[a] Metric units are reported for all the flue gas measurement data. To convert to alternate units: $^oF = 1.8 (^oC)+32$; cfm = cmm x 35.3.

[b] Volume % concentration on a dry basis.

[c] Plant O_2 results adjusted to a dry basis assuming 25% H_2O measured at the boiler outlet.

TABLE 5-4. SUMMARY OF OXYGEN AND CARBON DIOXIDE RESULTS

Run No.	ESP Inlet Method 3		ESP Outlet Method 3		CEM System O_2	Plant O_2 Analyzer
	% O_2	%CO_2	% O_2	%CO_2	% O_2	% O_2
1	3.9	16.3	5.9	14.1	13.1	3.6
2	4.7	15.1	5.4	14.6	12.7	2.4
3	5.2	15.1	5.3	15.3	10.9	3.2

Notes: 1. Volume % concentration on a dry basis
2. Plant O_2 results adjusted to dry basis using 25% H_2O.

data base. The leak was equivalent to dilution with clean ambient air, which can be confirmed using the carbon dioxide results. For a combustion process that uses air as the source of combustion oxygen, the relationship between the oxygen and carbon dioxide concentration in the flue gas is linear. The oxygen and carbon dioxide results from the Method 3 tests and the CEM system are plotted in Figure 5-4. The average CEM result (normalized to 3% O_2 and "as measured") and random, individual data points are presented in the plot. Although there is some scatter in the results, a linear relationship is confirmed. This linear relationship demonstrates that simple dilution was occuring and that there were no secondary calibration errors. Therefore, the species measurements normalized to 3% O_2 are valid and can be used to compare combustion conditions among test runs for CO_2, CO, SO_2, and NO_x.

The total hydrocarbon sample was collected through a separate sample line and pump system and leakage did not occur in this system. The flue gas oxygen concentration measured by the host site was essentially 3% on a dry basis, thus the THC results as measured are essentially on the same basis as the other species normalized to 3% O_2.

The mean value and standard deviation of the gas concentration for each of the species that was measured continuously at the recovery boiler outlet are presented in Table 5-5. A complete listing of the CEM data is included in Appendix A-2. A dilution correction for oxygen concentration cannot be calculated because there is no independent basis for computing an adjustment factor. However, the results as measured can be used to indicate the relative variation between runs.

The average oxygen concentration for Runs 1 - 3 ranged from 10.9 to 13.1 volume percent, dry basis with an average result of 12.2 percent. The concentrations are plotted versus test time in Figure 5-5. The oxygen measurements were relatively stable during each test run, and did not change significantly between runs. As discussed previously, the reported oxygen results are biased high, and are presented only to show the relative variation with time.

The carbon dioxide results are plotted versus time in Figure 5-6. The average carbon dioxide concentration on a dry basis, adjusted to 3% O_2, ranged

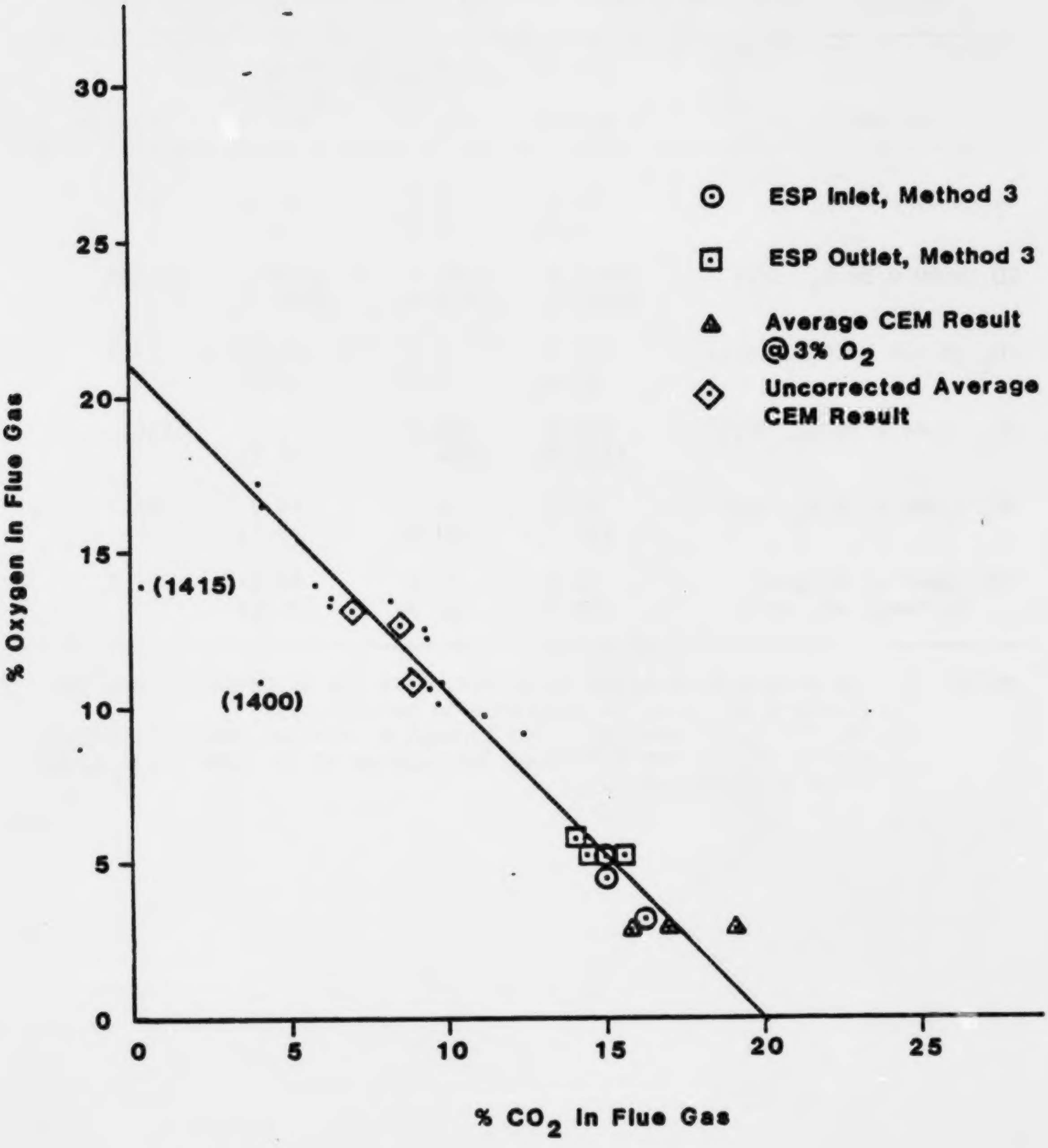


Figure 5-4. Volume Percent Oxygen Versus Volume Percent CO_2 in the Flue Gases, Site 05.

TABLE 5-5. MEAN VALUES AND STANDARD DEVIATIONS OF CONTINUOUSLY MONITORED COMBUSTION GASES AT THE RECOVERY BOILER OUTLET

Species	Average Concentration (Standard deviation) Run 01	Run 02	Run 03	Average
O_2 (% vol, dry)	13.1 (1.4)	12.7 (0.4)	10.9 (0.5)	12.2
CO (ppmv @ 3% O_2, dry)	10607.8 (2357.8)	12926.0 (1918.8)	9210.4 (2795.7)	10,900
CO_2 (% vol @ 3% O_2, dry)	17.0 (1.2)	19.2 (0.9)	16.1 (2.4)	17.4
SO_2 (ppmv @ 3% O_2, dry)	948.6 (272.8)	976.8 (264.6)	565.3 (143.9)	830
NO_x (ppmv @ 3% O_2, dry)	41.6 (15.7)	42.3 (11.2)	44.0 (9.1)	42.6
THC (ppmv as propane as measured, wet)	66.9 (43.7)	59.2 (27.8)	46.9 (46.8)	57.7

NOTES:
1. The mean concentration is presented as the upper entry, and the standard deviation is presented in parenthesis.
2. The THC sample was collected through a separate sample line/pump system and was not corrected for leakage on the same basis as the other measured species.

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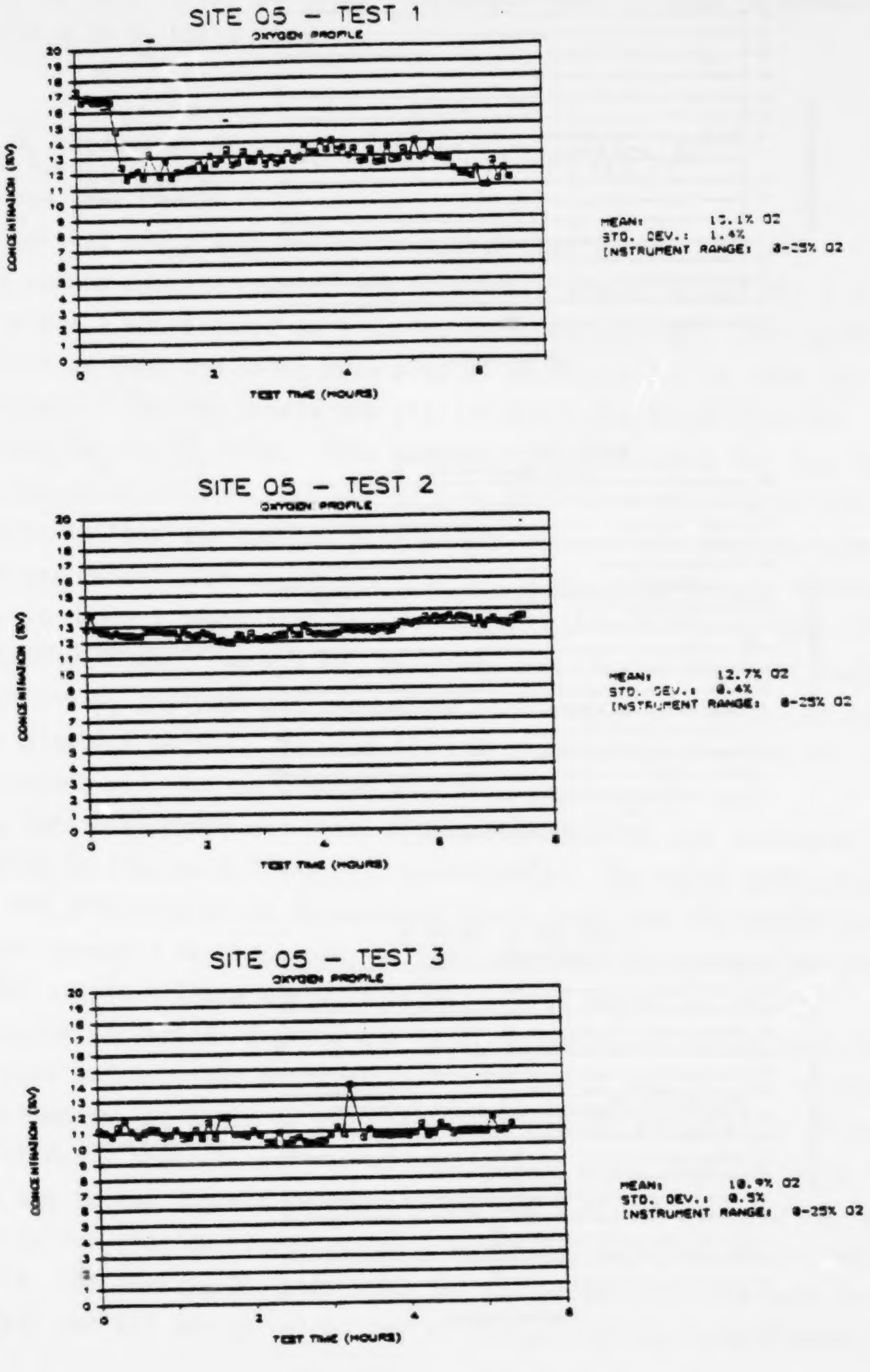
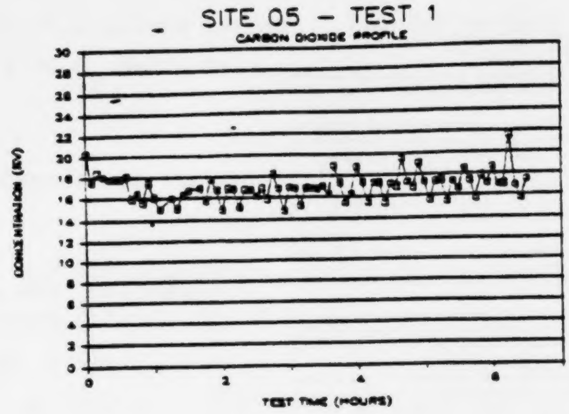
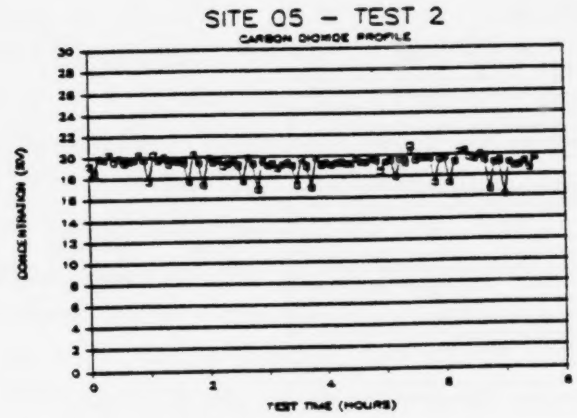


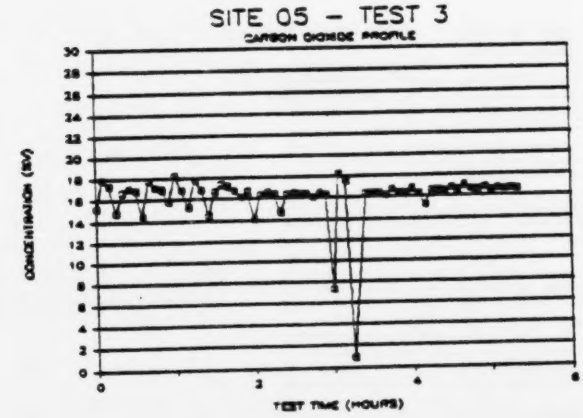
Figure 5-5. Oxygen Concentration Versus Test Time, Site 05.



MEAN: 17.0% CO2
STD. DEV.: 1.2%
INSTRUMENT RANGE: 0-20% CO2



MEAN: 19.2% CO2
STD. DEV.: 0.9%
INSTRUMENT RANGE: 0-20% CO2



MEAN: 16.1% CO2
STD. DEV.: 2.4%
INSTRUMENT RANGE: 0-20% CO2

Figure 5-6. Carbon Dioxide Concentration Versus Test Time, Site 05.

from 16.1 to 19.2 volume percent. The factor that is used to normalize the results to a 3% O_2 basis is:

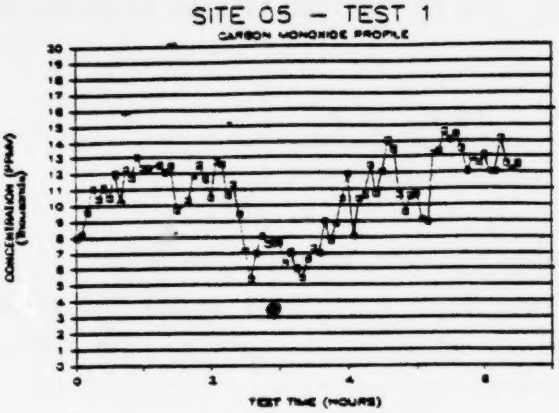
$$O_2 \text{ correction factor} = \frac{20.9 - 3\%\ O_2}{20.9 - \text{measured } \%\ O_2}$$

This factor was calculated for each 5 minute average data point.

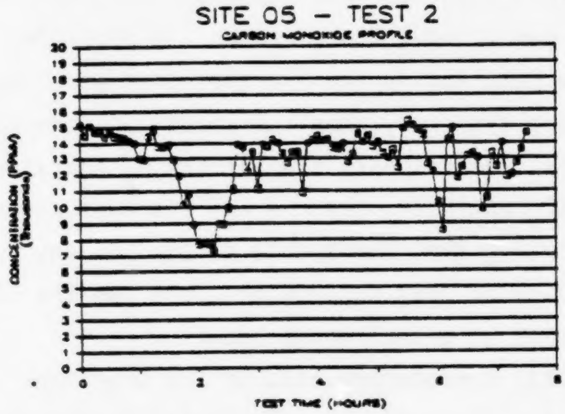
The carbon dioxide results are relatively stable except for a short period in Run 3 where there were two outlying data points. The points (identified as 1400 and 1415) were plotted on Figure 5-4 to test the validity of the values. The two points are significantly displaced from the theoretical CO_2 vs. O_2 line. This suggests that the cause for the low results is not combustion related, but due to some other reason. A possible explanation is that the two low data points are averages that were measured during a gas conditioner cleaning cycle or, when the probe was removed from the flue to collect a bag sample. The response time of the O_2 analyzer is significantly longer than the CO_2 analyzer, and the two averages could be a result of the O_2 analyzer not seeing the same sample as the CO_2 analyzer during a blowback period. Because of this uncertainty, the two low CO_2 concentrations will not be treated as a real occurrence.

The carbon monoxide and total hydrocarbon results are presented graphically in Figures 5-7 and 5-8 respectively. The total hydrocarbon results are presented on an as-measured basis since the THC sample was collected through a separate pump system. Dilution by leakage did not occur in the THC sample. There was a relatively large variation in the concentration of carbon monoxide and total hydrocarbons during each run, but the averages between runs was similar. Also the CO and THC variations tend to track each other, as would be expected. The average results for CO and THC are not directly proportional for all three test runs. However, this is probably due to the absence of about 1 1/2 hours of THC data during Run 1.

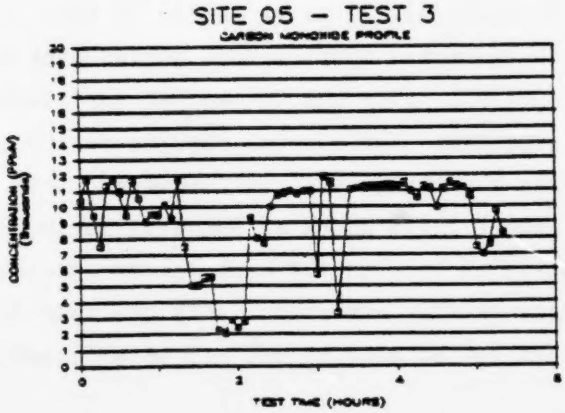
The sulfur dioxide concentration results for each run are presented in Figure 5-9. The average SO_2 concentration was essentially the same for Runs 1 and 2, (949 and 977 ppm by volume dry at 3% O_2), but was significantly less



MEAN: 10607.0 ppmv CO
STD. DEV.: 2257.0 ppmv
INSTRUMENT RANGE: 0-6000 ppmv CO

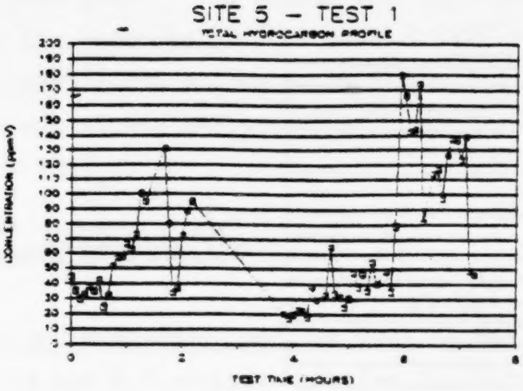


MEAN: 12926.0 ppmv CO
STD. DEV.: 1919.0 ppmv
INSTRUMENT RANGE: 0-6000 ppmv CO



MEAN: 9210.4 ppmv CO
STD. DEV.: 2795.7 ppmv
INSTRUMENT RANGE: 0-6000 ppmv CO

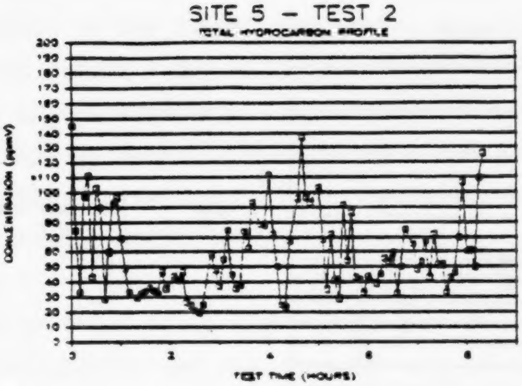
Figure 5-7. Carbon Monoxide Versus Test Time, Site 05.



Mean: 66.9 ppmv THC

Std. Dev.: 43.7 ppmv

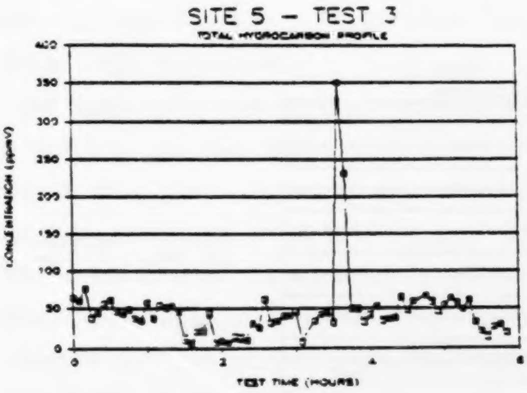
Instrument Range: 0-500 ppm THC



Mean: 59.2 ppmv THC

Std. Dev.: 27.8 ppmv

Instrument Range: 0-500 ppm THC

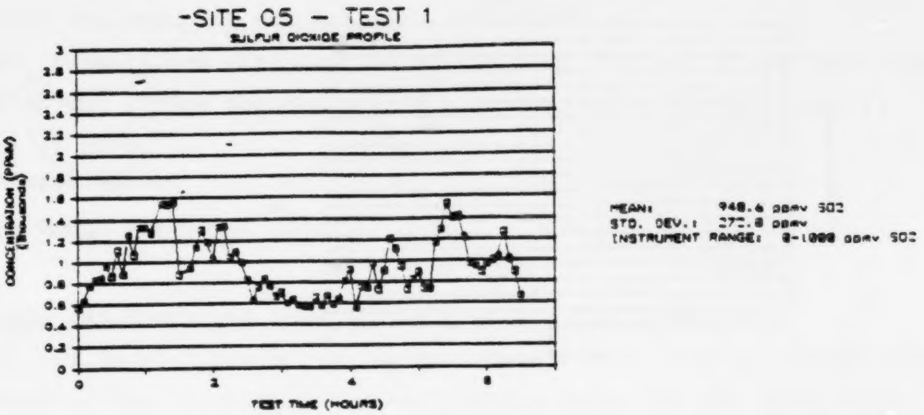


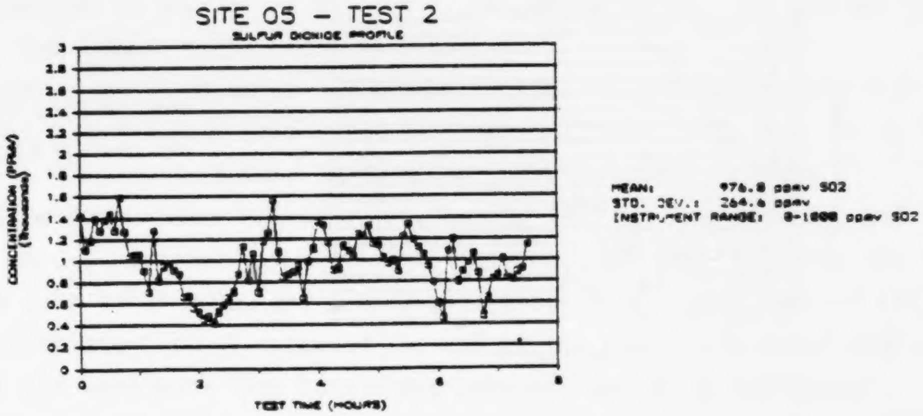
Mean: 46.9 ppmv THC

Std. Dev.: 46.8 ppmv

Instrument Range: 0-500 ppm THC

Figure 5-8. Total Hydrocarbon Concentration Versus Test Time, Site 05.





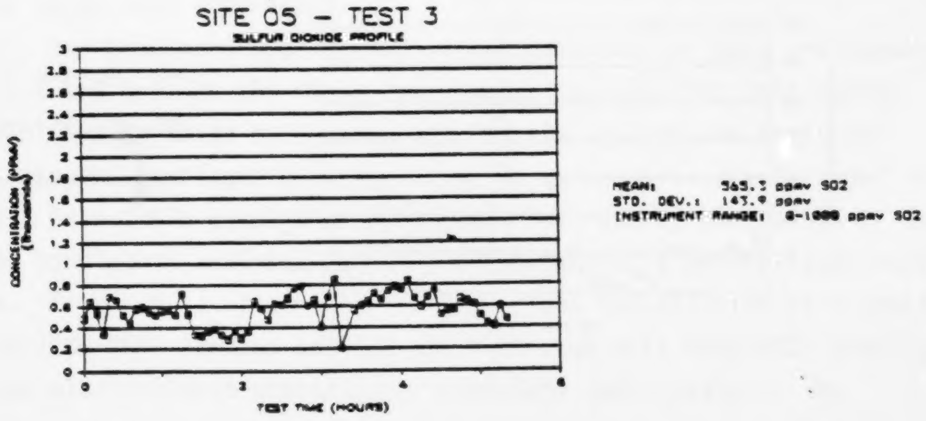


Figure 5-9. Sulfur Dioxide Concentration Versus Test Time, Site 05.

during Run 3 (565 ppmv). The reason for the reduced SO_2 emission is not apparent from the recorded process data.

The NO_x results are presented in Figure 5-10. For all three runs, the NO_x concentration was steady and essentially the same value of 42-44 ppm by volume, dry at 3% O_2.

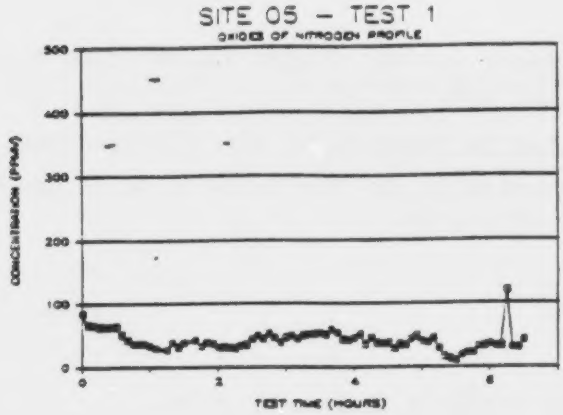
5.4 DIOXIN/FURAN EMISSIONS DATA

5.4.1 Isomer and Homologue Specific Data at the ESP Inlet

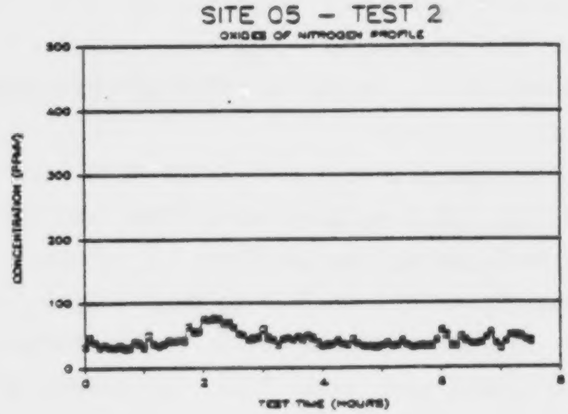
Tables 5-6 and 5-7 present emission concentrations and emissions rate data measured at the electrostatic precipitator inlet for the 2378 TCDD, isomer and total PCDD and total PCDF homologues. The data include dioxin and furan collection in the entire MM5 train, including filter, XAD sorbent trap, impingers, and sample train clean-up rinses.

Average as-measured emissions concentrations of total PCDD, and PCDF species were not-detected 2378 TCDD; 15.1 ng/dscm total PCDD; and .93 ng/dscm total PCDF. When corrected to 3% O_2 using the EPA Method 3 oxygen concentration data, these values correspond to 17.1 ng/dscm @ 3% O_2; and 1.07 ng/dscm @ 3% O_2, respectively. Average emission rates for the three species were 0.003 g/hr total PCDD, and 0.0002 g/hr total PCDF. Emissions of 2378 TCDD were consistently not detected for any of the runs. The total PCDD and PCDF emissions were much less consistent between runs which indicates significant variability. The maximum deviation of any individual run from the overall average was approximately 94 percent for total PCDD emissions and 70 percent for total PCDF emissions.

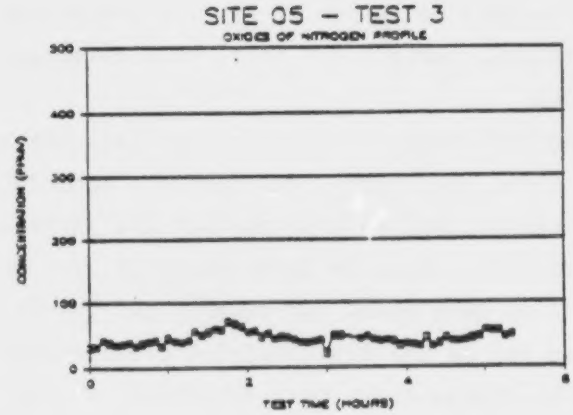
Isomer- and homologue-specific emission concentration data are summarized in Tables 5-8 and 5-9 for the three test runs. Run-specific data tables showing homologue emission concentrations in both ng/dscm and parts-per-trillion units and homologue emission rates in ug/hr units are included in Appendix D. Detectable quantities were found for roughly two-thirds of the isomers and homologues analyzed for at the electrostatic precipitator inlet of Site BLB-B. Figure 5-11 is a histogram that shows the relative distributions of the 2378 TCDD/TCDF isomers and the tetra-through octa PCDD/PCDF homologues in the inlet electrostatic precipitator emissions (mole basis). The



MEAN: 41.6 ppmv NOx
STD. DEV.: 13.7 ppmv
INSTRUMENT RANGE: 0-1000 ppmv NOx



MEAN: 42.3 ppmv NOx
STD. DEV.: 11.2 ppmv
INSTRUMENT RANGE: 0-300 ppmv NOx



MEAN: 44.0 ppmv NOx
STD. DEV.: 9.1 ppmv
INSTRUMENT RANGE: 0-300 ppmv NOx

Figure 5-10. Nitrogen Oxides Concentration Versus Test Time, Site 05.

Table 5-6. Overview of Dioxin/Furan Emissions Concentration Data for Site BLB-B (Electrostatic Precipitator Inlet)

Run Number	2378 TCDD	Total PCDD	Total PCDF
Emissions Concentration (as measured), ng/dscm			
Run 01	ND	.88	.26
Run 02	ND	3.1	.69
Run 03	ND	41.3	1.84
Average	--	15.1	.93
Emissions Rate Concentration (corrected to 3% O_2), ng/dscm @ 3% O_2			
Run 01	ND	.92	.28
Run 02	ND	3.37	.77
Run 03	ND	47.0	2.10
Average	--	17.1	1.07

ND = Not Detected

Table 5-7. Summary of Dioxin and Furan Emissions Rate Data for Site BLB-B (Electrostatic Precipitator Inlet)

Run Number	Dioxin/Furan Emission Rate, ug/hr 2378 TCDD	 Total PCDD	 Total PCDF
Run 01	ND	193	58
Run 02	ND	687	156
Run 03	ND	9270	413
Average	--	3383	209

ND = Not Detected

TABLE 5-8. SUMMARY OF DIOXIN/FURAN EMISSIONS DATA FOR SITE BLB-B INLET
(As-Measured Concentrations)

Dioxin/Furan Isomer	Isomer Concentration in Flue Gas (ng/dscm)			
	Run 01	Run 02	Run 03	Avg.
DIOXINS				
2378 TCDD	ND(3.95E-02)	ND(6.25E-02)	ND(2.43E-02)	.00E+00
Other TCDD	ND(3.95E-02)	ND(6.25E-02)	ND(2.43E-02)	.00E+00
Penta-CDD	ND(3.95E-02)	ND(6.94E-03)	ND(8.68E-02)	.00E+00
Hexa-CDD	ND(3.95E-02)	ND(8.68E-02)	2.08E-01	6.94E-02
Hepta-CDD	1.75E-01	7.29E-01	6.81E+00	2.57E+00
Octa-CDD	7.02E-01	2.33E+00	3.42E+01	1.24E+01
Total PCDD	8.77E-01	3.06E+00	4.13E+01	1.51E+01
FURANS				
2378 TCDF	4.39E-02	ND(6.25E-02)	6.94E-02	3.78E-02
Other TCDF	4.39E-02	ND(6.25E-02)	4.51E-01	1.65E-01
Penta-CDF	ND(1.05E-01)	ND(3.47E-02)	ND(8.68E-02)	.00E+00
Hexa-CDF	8.77E-02	1.04E-01	2.43E-01	1.45E-01
Hepta-CDF	4.39E-02	3.47E-01	6.25E-01	3.39E-01
Octa-CDF	4.39E-02	2.43E-01	4.51E-01	2.46E-01
Total PCDF	2.63E-01	6.94E-01	1.84E+00	9.33E-01

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

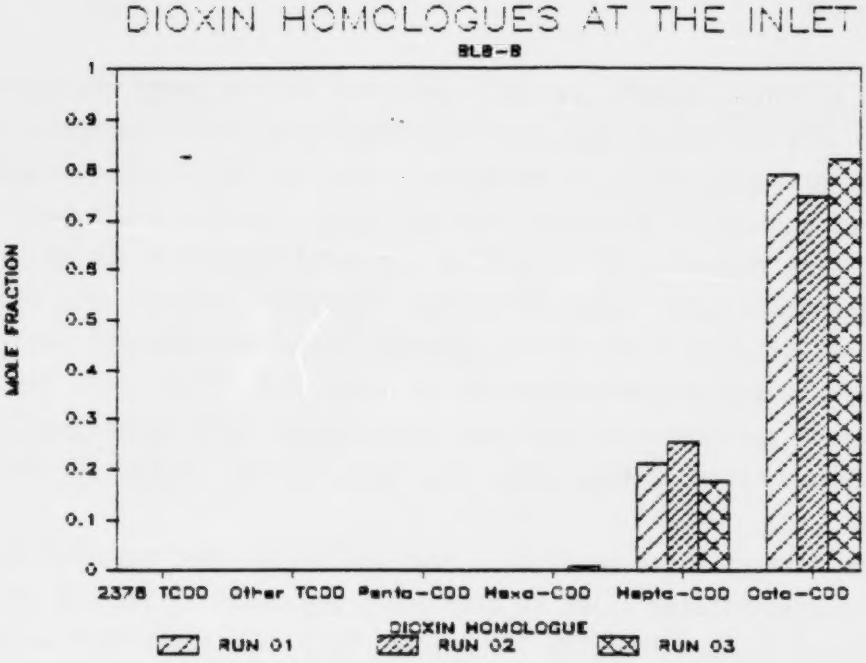
ND = not detected (detection limit in parentheses).
ng = 1.0E-09g
8760 operating hours per year

TABLE 5-9. SUMMARY OF DIOXIN/FURAN EMISSIONS DATA FOR SITE BLB-B INLET (Concentrations Corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration in Flue Gas (ng/dscm @ 3% oxygen)			
	Run 01	Run 02	Run 03	Avg.
DIOXINS				
2378 TCDD	ND(4.15E-02)	ND(6.90E-02)	ND(2.77E-02)	.00E+00
Other TCDD	ND(4.15E-02)	ND(6.90E-02)	ND(2.77E-02)	.00E+00
Penta-CDD	ND(4.15E-02)	ND(7.67E-03)	ND(9.89E-02)	.00E+00
Hexa-CDD	ND(4.15E-02)	ND(9.59E-02)	2.37E-01	7.91E-02
Hepta-CDD	1.84E-01	8.05E-01	7.75E+00	2.91E+00
Octa-CDD	7.37E-01	2.57E+00	3.90E+01	1.41E+01
Total PCDD	9.22E-01	3.37E+00	4.70E+01	1.71E+01
FURANS				
2378 TCDF	4.61E-02	ND(6.90E-02)	7.91E-02	4.17E-02
Other TCDF	4.61E-02	ND(6.90E-02)	5.14E-01	1.87E-01
Penta-CDF	ND(1.11E-01)	ND(3.83E-02)	ND(9.89E-02)	.00E+00
Hexa-CDF	9.22E-02	1.15E-01	2.77E-01	1.61E-01
Hepta-CDF	4.61E-02	3.83E-01	7.12E-01	3.81E-01
Octa-CDF	4.61E-02	2.68E-01	5.14E-01	2.76E-01
Total PCDF	2.77E-01	7.67E-01	2.10E+00	1.05E+00

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = not detected (detection limit in parentheses).
ng = 1.0E-09g
8760 operating hours per year



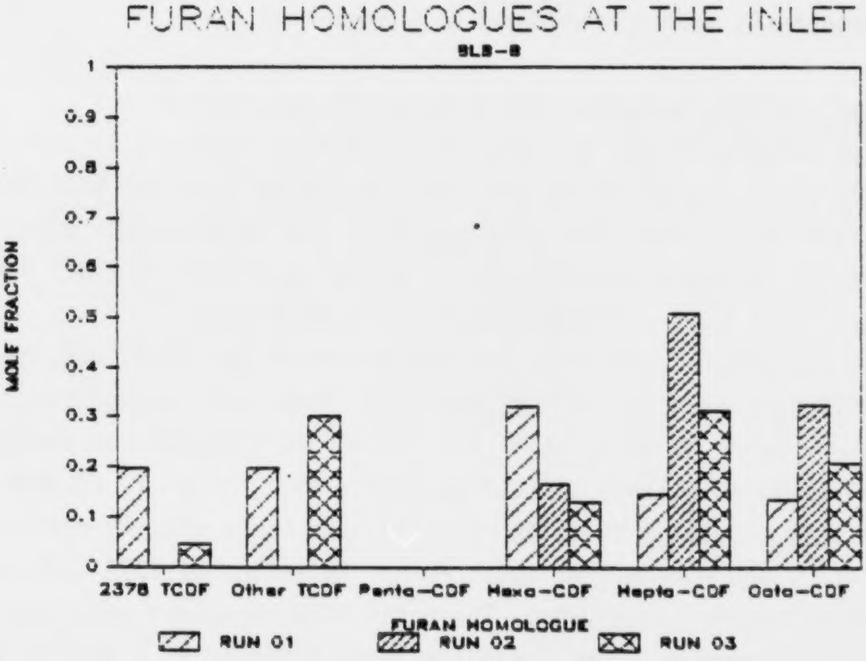


FIGURE 5-11. DIOXIN AND FURAN HOMOLOGUE DISTRIBUTIONS OF THE ELECTROSTATIC PRECIPITATOR INLET EMISSIONS FOR SITE BLB-B

distribution of dioxin species was extremely non-uniform among the various homologues. Only the hepta- and octa- CDD homologues were detectable in the electrostatic precipitator inlet emissions. The octa-CDD homologue accounted for roughly 80 percent of the total dioxins found. The hepta-CDD homologues accounted for the remaining 20 percent of the total dioxins found in the electrostatic precipitator inlet emissions. The furan species were more uniformly distributed than the dioxin species, with the hepta-CDF homologue being the largest single contributor to the total PCDF emissions. The contributions of the tetra- through octa-chlorinated furan homologues to the total PCDF were: tetra, 0-49%; penta, 0%; hexa, 12-28%, hepta, 13-50%, and octa, 11-33%.

Emission factors based on black liquor dry solids feed rate for the electrostatic precipitator inlet at site BLB-B are shown in Table 5-10. Average emission factors for 2378 TCDD, total PCDD, and total PCDF were 0 g 2378 TCDD emitted per Kg feed; .06 ug total PCDD emitted per Kg feed; and .004 ug total PCDF emitted per Kg feed. Emission factors for the various dioxin and furan homologues varied considerably between test runs.

5.4.2 Isomer and Homologue Specific Data at the ESP Outlet

Emission concentrations and emissions rate data measured at the electrostatic precipitator outlet are shown in Tables 5-11 and 5-12 for the 2378 TCDD, total PCDD, and total PCDF species. The data include dioxin and furan collection in the entire MM5 train, including filter, primary XAD sorbent trap, impingers, and sample train clean-up rinses.

Average as-measured emissions concentrations of the 2378 TCDD, total PCDD, and PCDF species were 1.02 ng/dscm total PCDD; and .60 ng/dscm total PCDF. When corrected to 3% O_2 using the EPA Method 3 oxygen concentration data, these values correspond to 1.19 ng/dscm @ 3% O_2; and .71 ng/dscm @ 3% O_2, respectively. Average emission rates for the three species were 0.0002 g/hr total PCDD, and 0.0001 g/hr total PCDF. Emissions of 2378 TCDD were non-detectable for all three runs. The total PCDD emissions were consistent for runs 2 and 3; however, run 1 emissions were a factor of 2 greater for total PCDD. PCDF emissions were less consistent between runs which indicates considerable variability. The maximum deviation of any individual run from

TABLE 5-10. DIOXIN/FURAN EMISSION FACTORS FOR SITE BLB-B INLET

Dioxin/Furan Isomer	Dioxin/Furan Emission Factors (ug/kg)			
	Run 01	Run 02	Run 03	Avg.
DIOXINS				
2378 TCDD	ND(1.53E-04)	ND(2.47E-04)	ND(9.60E-05)	.00E+00
Other TCDD	ND(1.53E-04)	ND(2.47E-04)	ND(9.60E-05)	.00E+00
Penta-CDD	ND(1.53E-04)	ND(2.74E-05)	ND(3.43E-04)	.00E+00
Hexa-CDD	ND(1.53E-04)	ND(3.43E-04)	8.23E-04	2.74E-04
Hepta-CDD	6.81E-04	2.88E-03	2.69E-02	1.01E-02
Octa-CDD	2.72E-03	9.19E-03	1.35E-01	4.90E-02
Total PCDD	3.40E-03	1.21E-02	1.63E-01	5.94E-02
FURANS				
2378 TCDF	1.70E-04	ND(2.47E-04)	2.74E-04	1.48E-04
Other TCDF	1.70E-04	ND(2.47E-04)	1.78E-03	6.51E-04
Penta-CDF	ND(4.09E-04)	ND(1.37E-04)	ND(3.43E-04)	.00E+00
Hexa-CDF	3.40E-04	4.11E-04	9.60E-04	5.70E-04
Hepta-CDF	1.70E-04	1.37E-03	2.47E-03	1.34E-03
Octa-CDF	1.70E-04	9.60E-04	1.78E-03	9.71E-04
Total PCDF	1.02E-03	2.74E-03	7.27E-03	3.68E-03

ND = not detected (detection limit in parentheses).
ug = 1.0E-06g
8760 operating hours per year

Table 5-11. Overview of Dioxin and Furan Emissions Concentration Data for Site BLB-B (Electrostatic Precipitator Outlet)

Run Number	2378 TCDD	Total PCDD	Total PCDF
Emissions Concentration (as measured), ng/dscm			
Run 01	ND	1.58	1.32
Run 02	ND	0.71	.12
Run 03	ND	0.77	.36
Average	--	1.02	.60
Emissions Rate Concentration (corrected to 3% O_2), ng/dscm @ 3% O_2			
Run 01	ND	1.88	1.57
Run 02	ND	.81	0.14
Run 03	ND	.90	.42
Average	--	1.19	.71

ND = Not Detected

Table 5-12. Summary of Dioxin and Furan Emissions Rate Data for Site BLB-B (Electrostatic Precipitator Outlet)

Run Number	Dioxin/Furan Emission Rate, ug/hr		
	2378 TCDD	Total PCDD	Total PCDF
Run 01	ND	355	296
Run 02	ND	156	26.1
Run 03	ND	179	84.4
Average	--	230	136

ND = Not Detected

the overall average was approximately 35 percent for total PCDD emissions and 80 percent for total-PCDF emissions. Therefore, the between run variability is within the range expected given the analytical uncertainty.

Isomer- and homologue specific emission concentration data are summarized in Tables 5-13 and 5-14 for the three test runs. Run-specific data tables showing homologue emission concentrations in both ng/dscm and parts-per-trillion units and homologue emission rates in ug/hr units are included in Appendix D. Figure 5-12 is a histogram that shows the relative distributions of the 2378 TCDD/TCDF isomers and the tetra- through octa PCDD/PCDF homologues in the electrostatic precipitator outlet emissions (mole fraction basis). The distribution of dioxin species was non-uniform among the various homologues. Only the hexa, hepta, and octa-CDD homologues were detectable in the electrostatic precipitator outlet emissions. The octa-CDD homologue accounted for roughly 70 percent of the total dioxins found. The contributions (on a mole-basis) of the hexa- and hepta-CDD dioxin homologue to the total TCDD were: hexa, 0-13%; and hepta, 20-25%. The total PCDD and PCDF emissions were more evenly distributed than the dioxin species with the contributions of the tetra- through octa-chlorinated furan homologues to the total PCDF as follows: tetra, 10-35%; penta, 0%; hexa, 0-53%; hepta, 18-62%; and octa, 5-38%.

Emission factors for the electrostatic precipitator outlet at site BLB-B are shown in Table 5-15. Average emission factors for 2378 TCDD and total PCDD, and total PCDF were 0.004 ug total PCDD emitted per Kg feed; 0.002 ug total PCDF emitted per Kg feed. Emission factors for the various dioxin and furan homologues were fairly consistent between test runs.

5.4.3 Reduction of Dioxin/Furan Concentrations Due to the ESP

The dioxins/furans which condense on particulate in the stack gas are removed from the stack gas along with the particulate by the pollution control device (ESP). The dioxin/furan removal efficiency of the control device is calculated from the difference of the inlet and outlet concentration of each dioxin/furan homlogue divided by the inlet concentration of each homlogue. Each value is considered to have an analytical uncertainty of ±50%. An analysis of the uncertainty of the control device efficiency (contained in

TABLE 5-13. SUMMARY OF DIOXIN/FURAN EMISSIONS DATA FOR SITE BLB-B OUTLET

Dioxin/Furan Isomer	Isomer Concentration in Flue Gas (ng/dscm) Run 01	Run 02	Run 03	Avg.
DIOXINS				
2378 TCDD	ND(3.01E-02)	ND(1.18E-02)	ND(2.49E-02)	.00E+00
Other TCDD	ND(3.01E-02)	ND(1.18E-02)	ND(2.49E-02)	.00E+00
Penta-CDD	ND(4.51E-02)	ND(3.29E-02)	ND(1.36E-01)	.00E+00
Hexa-CDD	1.88E-01	ND(8.47E-02)	6.79E-02	8.53E-02
Hepta-CDD	3.38E-01	1.65E-01	1.58E-01	2.20E-01
Octa-CDD	1.05E+00	5.41E-01	5.43E-01	7.12E-01
Total PCDD	1.58E+00	7.06E-01	7.69E-01	1.02E+00
FURANS				
2378 TCDF	ND(3.76E-02)	ND(4.00E-02)	2.26E-02	7.54E-03
Other TCDF	2.63E-01	ND(4.00E-02)	6.79E-02	1.10E-01
Penta-CDF	ND(2.74E-01)	ND(3.29E-02)	ND(1.36E-01)	.00E+00
Hexa-CDF	7.14E-01	ND(1.36E-01)	1.36E-01	2.83E-01
Hepta-CDF	2.63E-01	7.06E-02	9.05E-02	1.41E-01
Octa-CDF	7.52E-02	4.71E-02	4.52E-02	5.58E-02
Total PCDF	1.32E+00	1.18E-01	3.62E-01	5.98E-01

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

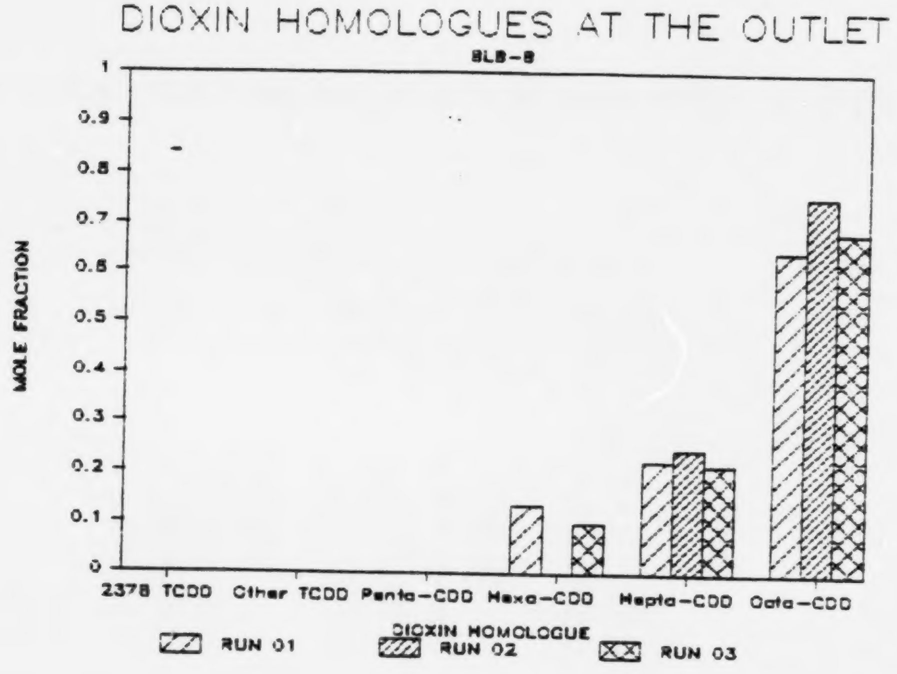
ND = not detected (detection limit in parentheses).
ng = 1.0E-09g
8760 operating hours per year

TABLE 5-14. SUMMARY OF DIOXIN/FURAN EMISSIONS DATA FOR SITE BLB-B OUTLET (Concentrations Corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration in Flue Gas (ng/dscm @ 3% oxygen) Run 01	Run 02	Run 03	Avg.
DIOXINS				
2378 TCDD	ND(3.59E-02)	ND(1.36E-02)	ND(2.85E-02)	.00E+00
Other TCDD	ND(3.59E-02)	ND(1.36E-02)	ND(2.85E-02)	.00E+00
Penta-CDD	ND(5.38E-02)	ND(3.80E-02)	ND(1.56E-01)	.00E+00
Hexa-CDD	2.24E-01	ND(9.77E-02)	7.78E-02	1.01E-01
Hepta-CDD	4.03E-01	1.90E-01	1.82E-01	2.58E-01
Octa-CDD	1.25E+00	6.24E-01	6.23E-01	8.34E-01
Total PCDD	1.88E+00	8.14E-01	8.82E-01	1.19E+00
FURANS				
2378 TCDF	ND(4.48E-02)	ND(4.62E-02)	2.59E-02	8.65E-03
Other TCDF	3.14E-01	ND(4.62E-02)	7.78E-02	1.31E-01
Penta-CDF	ND(3.27E-01)	ND(3.80E-02)	ND(1.56E-01)	.00E+00
Hexa-CDF	8.51E-01	ND(1.57E-01)	1.56E-01	3.36E-01
Hepta-CDF	3.14E-01	8.14E-02	1.04E-01	1.66E-01
Octa-CDF	8.96E-02	5.43E-02	5.19E-02	6.53E-02
Total PCDF	1.57E+00	1.36E-01	4.15E-01	7.06E-01

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = not detected (detection limit in parentheses).
ng = 1.0E-09g
8760 operating hours per year



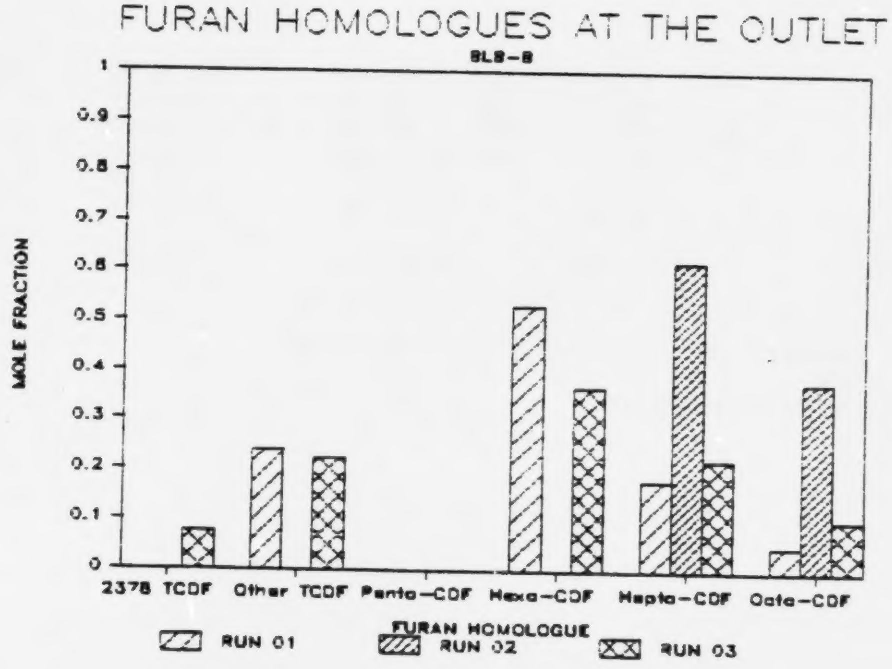


FIGURE 5-12. DIOXIN AND FURAN HOMOLOGUE DISTRIBUTIONS OF THE ELECTROSTATIC PRECIPITATOR OUTLET EMISSIONS FOR SITE BLB-B

TABLE 5-15. DIOXIN/FURAN EMISSION FACTORS FOR SITE BLB-B OUTLET

Dioxin/Furan Isomer	Dioxin/Furan Emission Factors (ug/kg)			
	Run 01	Run 02	Run 03	Avg.
DIOXINS				
2378 TCDD	ND(1.19E-04)	ND(4.58E-05)	ND(1.02E-04)	.00E+00
Other TCDD	ND(1.19E-04)	ND(4.58E-05)	ND(1.02E-04)	.00E+00
Penta-CDD	ND(1.79E-04)	ND(1.28E-04)	ND(5.56E-04)	.00E+00
Hexa-CDD	7.46E-04	ND(3.30E-04)	2.78E-04	3.41E-04
Hepta-CDD	1.34E-03	6.42E-04	6.49E-04	8.78E-04
Octa-CDD	4.18E-03	2.11E-03	2.22E-03	2.84E-03
Total PCDD	6.27E-03	2.75E-03	3.15E-03	4.06E-03
FURANS				
2378 TCDF	ND(1.49E-04)	ND(1.56E-04)	9.27E-05	3.09E-05
Other TCDF	1.04E-03	ND(1.56E-04)	3.71E-04	4.72E-04
Penta-CDF	ND(1.09E-03)	ND(1.28E-04)	ND(5.56E-04)	.00E+00
Hexa-CDF	2.83E-03	ND(5.32E-04)	5.56E-04	1.13E-03
Hepta-CDF	1.04E-03	2.75E-04	3.71E-04	5.63E-04
Octa-CDF	2.98E-04	1.83E-04	1.85E-04	2.22E-04
Total PCDF	5.22E-03	4.58E-04	1.58E-03	2.42E-03

ND = not detected (detection limit in parentheses).
ug = 1.0E-06g
8760 operating hours per year

Appendix L) indicated that with a measured efficiency of greater than 66.7%, the removal efficiency is most likely positive. With measured efficiencies between 66.7% and -200%, a definite conclusion cannot be drawn concerning the true removal efficiency is most likely negative.

The measured ESP removal efficiencies for each dioxin/furan homlogue at Site BLB-B are summarized in Table 5-16. In general, the average removal efficiencies for all homologues indicated positive true removal efficiency for the ESP. However, some of the homologues had measured removal efficiencies in the inconclusive range.

5.5 BLACK LIQUOR PRECURSOR DATA

As discussed in Section 4.3.2, the strong black liquor was sampled at Site BLB-B. These samples were analyzed for chlorinated benzenes, chlorinated biphenyls, and chlorinated phenols.

Table 5-17 summarizes the results of the compound-specific precursor analyses. Trace levels of pentachlorophenols were detected for Run 02, but overall the specific precursors analyzed for (i.e., chlorobenzenes, chlorophenols, and chlorinated biphenyls) were not detected. The phenol surrogate recovery data supports the problems (extraction and cleanup encountered with the dirty field samples (see Table 8-7).

Table 5-18 presents the results of the strong black liquor and weak black liquor total chloride analyses. The chloride concentration was consistent among the three test runs. The greatest deviation of any run from the overall average was 12 percent for the strong black liquor and 6 percent for the weak black liquor. As seen from Table 5-17, the strong black liquor was about three times as concentrated as the weak black liquor with respect to total chloride content. This increase in chloride content follows directly from the process since the dirty water from the brown stock washers (i.e., weak black liquor) is sent to an evaporation system for solids concentration prior to being fired into the boiler.

Total organic halide (TOX) analysis of an hourly composite sample of black liquor from test Run 01 showed no presence of TOX in the boiler feed. (Nondetected; Detection Limit). The detection limit of the analysis was approximately 4 ppm (4 ug/g). The data is inconclusive due to the "dirty"

TABLE 5-16. ESP REMOVAL EFFICIENCIES AT SITE BLB-B

Homologue	ESP Removal Efficiency, (%) Run 01	Run 02	Run 03	Average
Dioxins				
2378 TCDD	a	a	a	a
Other TCDD	a	a	a	a
Penta-CDD	a	a	a	a
Hexa-CDD	b	b	67.3	67.3
Hepta-CDD	-93.1	77.4	97.7	27.3
Octa-CDD	-49.6	76.8	98.4	41.8
Total PCDD	-80.2	76.9	98.1	31.6
Furans				
2378 TCDF	100.0	a	68.1	84.0
Other TCDF	-497.7	a	84.9	-206.4
Penta-CDF	a	a	a	a
Hexa-CDF	-711.4	100.0	44.0	-189.1
Hepta-CDF	-497.9	79.8	85.6	-110.8
Octa-CDF	-70.5	80.7	90.0	33.4
Total PCDF	-396.2	83.1	80.4	-77.6

[a] None detected

[b] Efficiency could not be determined; ND at the inlet, concentration reported at the outlet.

TABLE 5-17. SUMMARY OF DIOXIN PRECURSOR DATA FOR SITE BLB-B FEED SAMPLES

	Precursor Concentration, ug/g (ppm)			
	Black Liquor Feed			
Precursor Categories	Run 01	Run 02	Run 03	Average
Total Chlorinated Benzenes	ND	ND	ND	--
Total Chlorinated Biphenyls	ND	ND	ND	--
Total Chlorinated Phenols*	ND	trace	ND	--

ND = not detected. Detection limit = 4 ppm.

* Cleanup problems with acids fraction. See Table 8-7 for surrogate recoveries.

Table 5-18. Total Chloride Analyses of the Black Liquor Samples for Site BLB-B

Liquor	Run No.	Total Chloride Concentration (ug/g)
Strong Black Liquor	01	4604.9
	02*	5329.8
	03	5910.5
	Average	5281.7
Weak Black Liquor	01	1714.0
	02	1893.7
	03	1725.0
	Average	1777.6

*The average value reported for duplicates.

nature of the samples. Table 8-7 shows the problems found with surrogate recoveries for phenols.

5.6 AUXILIARY PROCESS SAMPLE ANALYSES

In addition to the chloride analysis performed on each HCl train. chloride analysis was also performed on the strong black liquor, weak black liquor, white liquor, by-product saltcake, neutralized spent acid, and the make-up water (well water) samples collected at Site BLB-B. The results of the strong and weak black liquor chloride analyses are presented in Section 5.4, Precursor Data. Table 5-19 summarizes the data obtained from the total chloride analyses of the other process samples mentioned above. The majority of the chlorine entering the black liquor circuit comes from the neutralized spent acid, the by-product salt cake, and the well water used for process make-up with each contributing 9.67, 13.9, and 911 g chlorine/mg of solids burned, respectively.

5.7 HCl TRAIN CHLORIDE EMISSIONS DATA

Table 5-20 summarizes HCl train chloride emissions data measured at the electrostatic precipitator outlet sampling location. The data are reported as "front half," "back half," and "train total" chloride emissions. The front half emissions represent chlorides captured in the probe rinse/filter fraction of the HCl train, which may include metal chlorides contained in the particulate matter. The back half emissions represent chlorides captured in the HCl sample train impingers, which would include HCl and any metal chlorides that pass through the sample train filter. The train total emissions represent the sum of the front half and back half emissions.

As shown in Table 5-20, the average as-measured train-total chloride emissions concentration was approximately 2.1 mg/dscm (0.001 grains/dscf). Corrected to 3% O_2 using the EPA Method 3 data, this corresponds to approximately 2.5 mg/dscm @ 3% O_2 (.001 gr/dscf @ 3% O_2). The train total chloride mass emission rate from the electrostatic precipitator outlet exhaust stack was about 0.44 Kg/hr (0.968 lb/hr). Chloride emissions were non-uniformly distributed between the front half and back half of the HCl sample train.

Table 5-19. Summary of Total Chloride[a] Data for Site BLB-B

Test Run	Neutralized Spent Acid	By-Product Salt Cake	White Liquor	Make-Up Water (Well Water)
01	820	1200	NA[b]	240
02	NA[b]	1100	7800	230
03	790	1300	4500	230
Average	805	1200	6150	230

[a] All concentrations expressed as ug/g as Cl^-.

[b] The sample was Parr-bombed and the result was invalid.

TABLE 5-20. HCl TRAIN CHLORIDE EMISSIONS DATA FOR SITE BLB-B AT THE ELECTROSTATIC PRECIPITATOR OUTLET

Parameter	Run 01	Run 02	Run 03	Average
Total Chloride Concentration (mg/dscm, as measured)				
Front Half	2.69	0.63	2.40	1.91
Back Half	ND	0.58	ND	0.58
Train Total	2.69	1.21	2.40	2.10
Total Chloride Concentration (mg/dscm, corrected to 3% Oxygen)[a]				
Front Half	3.21	0.75	2.86	2.27
Back Half	ND	0.69	ND	0.69
Train Total	3.21	1.44	2.86	2.50
Total Chloride Mass Emission Rate (Kg/hr)				
Front Half	0.537	0.138	0.514	0.40
Back Half	ND	0.128	ND	0.128
Train Total	0.537	0.266	0.514	0.44

[a] Concentration corrected to 3% O_2 using the equation:

$[Cl^-]$ @ 3% O_2 = $[Cl^-]$, as measured x $(20.9 - 3)/(20.9 - \%O_2)$

Compared with other Tier 4 test sites, Site BLB-B showed relatively low chloride emissions based on the total train catch. The corrected concentration range for all test sites for which HCl sampling was performed was 2.4 to 8800 mg/dscm @ 3% O_2 (0.001 to 3.8 gr/dscf @ 3% O_2), while the Site BLB-B average was 2.5 mg/dscm @ 3% O_2 (.001 gr/dscf @ 3% O_2).

5.8 SOIL SAMPLING DATA

Dioxin/furan analyses are currently being performed on the soil sample obtained at Site BLB-B.

6.0 SAMPLING LOCATIONS AND PROCEDURES

Samples were collected from ten different locations at Site BLB-B. Three of the locations were for gaseous sampling, five were for liquid sampling, and two were for solid sampling. The source sampling and analysis matrix in Table 4-1 lists the sample locations, measured parameters, sampling methods, and analytical methods that were used.

Details on the sampling locations and methods are discussed in Section 6.1 through 6.3. Analytical procedures for continuous monitoring of CO, CO_2, O_2, NO_x, SO_2, and THC are included in Section 6.1. All other analytical procedures are discussed in Section 7.

6.1 GASEOUS SAMPLING

Four types of gaseous samples were collected during this test program: Modified Method 5 (MM5), HCl, EPA Method 3, and continuous monitoring (CEM). The sampling locations and methods are further discussed in this section.

6.1.1 Gaseous Sampling Locations

6.1.1.1 ESP Outlet. The electrostatic precipitator outlet sampling location is identified as point "E" in Figure 4-1. The sampling ports are located in the 12.ft. diameter exhaust stack serving the ESP. Four ports at 90° orientation are located approximately 24 ft. (2 duct diameters) downstream of the induced draft fan and over 48 ft. (4 duct diameters) upstream of the stack exhaust to atmosphere. A total of 24 traverse points, 12 on each of 2 diameters, were used for stack gas velocity measurements and MM5 sampling. The location of the sampling ports and the traverse point layout are shown in Figures 6-1. and 6-2, respectively.

6.1.1.2 ESP Inlet. The electrostatic precipitator inlet sampling location is identified as point D in Figure 4-1. The ESP inlet gas stream flows through two similar ducts, designated as the North and South ducts. Sampling ports

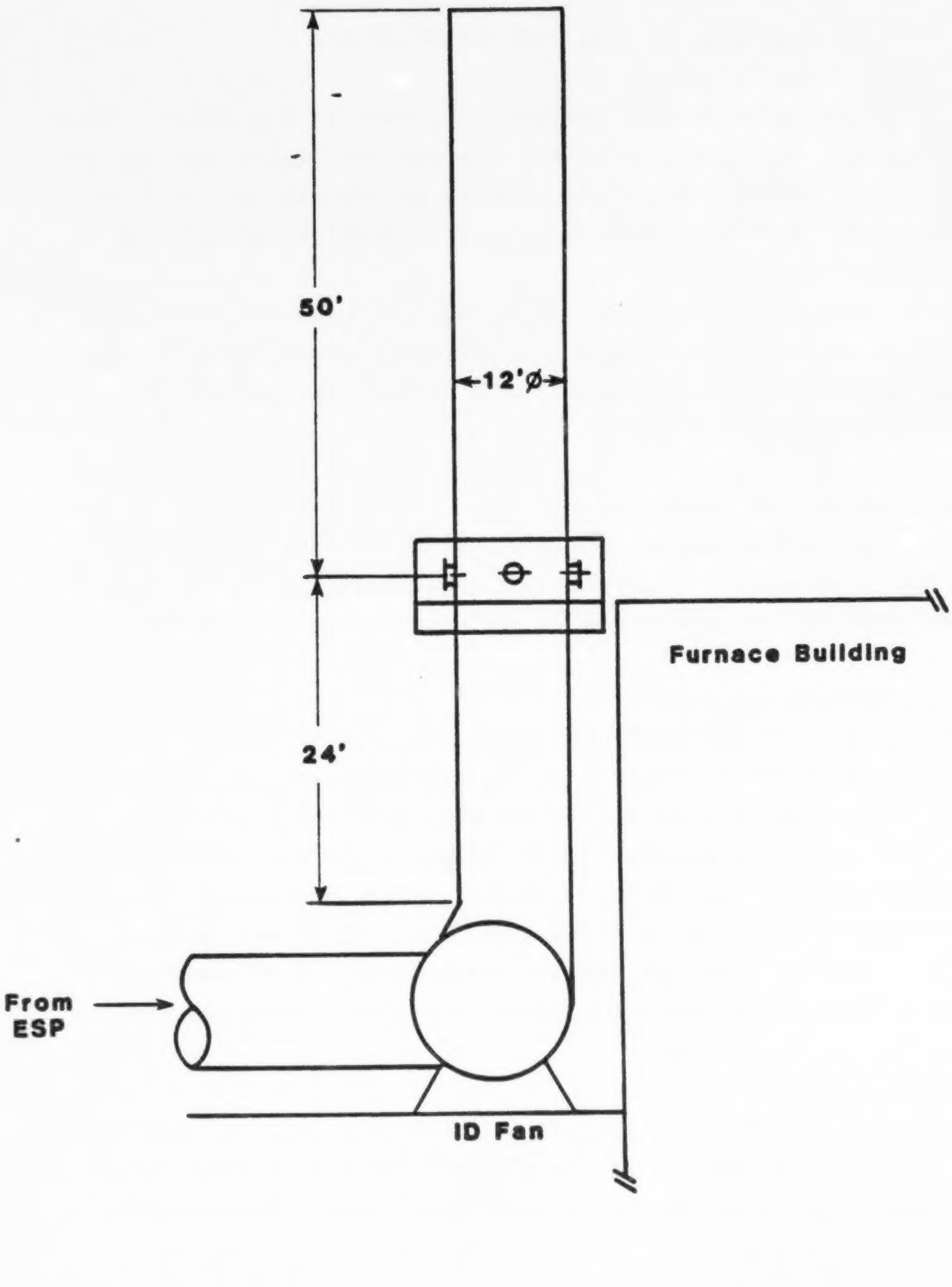


Figure 6-1. ESP Outlet Port Location, Site BLB-B

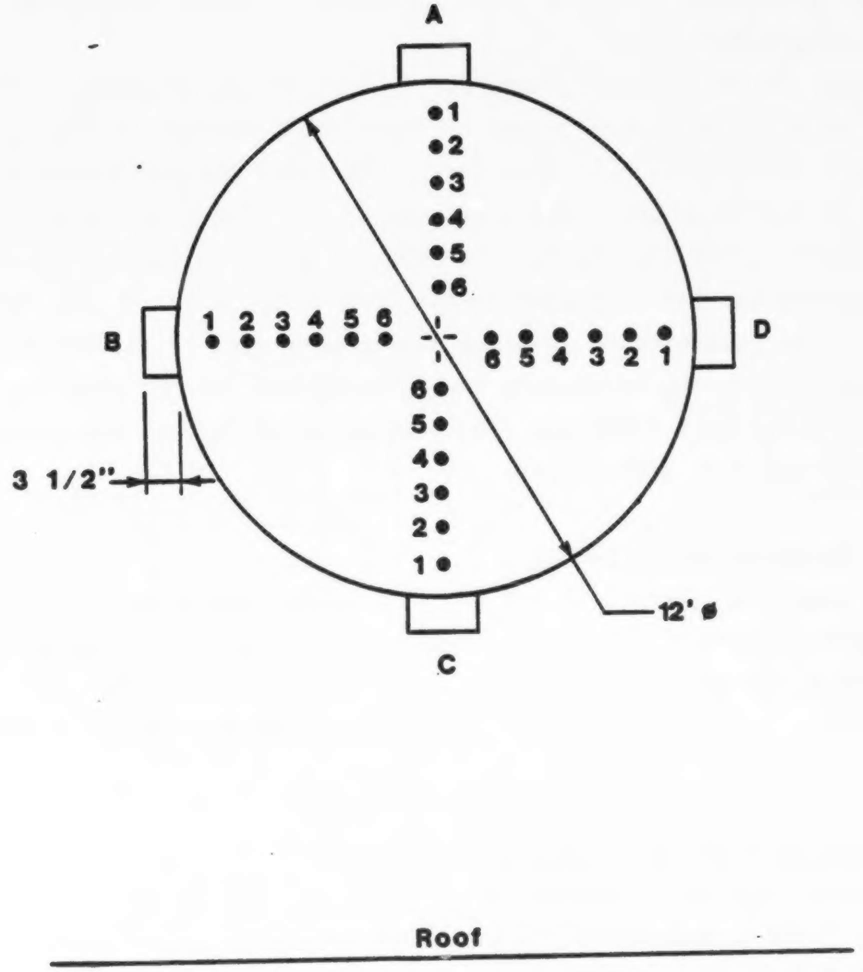


Figure 6-2. Sample Point Layout, ESP Outlet Site 05.

are located similarly in each of the two horizontal 7.5 ft. diameter ducts. Two ports at 90^0 orientation are located 25 ft (3.3 duct diameters) downstream of a bend in the ductwork, and 18 ft. (2.4 duct diameters) upstream of the entrance to the ESP.

A total of 24 traverse points (12 on each of two diameters) were to be used for velocity measurements and MM5 sampling. However, a dust accumulation was present in the bottom of each duct. The clear depth measured through the top port at the North and South ducts was 83 1/2 inches as compared to the stack diameter of 89 1/2 inches. In order to avoid collection of re-entrained dust, sampling was not conducted at the lower four points on the vertical traverse. The remaining 20 traverse points were used to measure gas velocity at the North duct, and to measure gas velocity and for MM5 sampling in the South duct. The port locations and traverse point layouts are given in Figures 6-3 and 6-4 respectively.

6.1.1.3 Recovery Boiler Outlet.

The sampling location at the recovery boiler outlet was located between the furnace and the direct contact evaporator outlet. This location is identified as point C in Figure 4-1. The single sampling port is located in a rectangular duct. The continuous monitoring probe was located 2 feet into the duct.

6.1.2 Gaseous Sampling Procedures

Gaseous sampling procedures used during the testing are listed in Table 6-1. These procedures are discussed in detail in the Tier 4 Quality Assurance Project Plan (QAPP). A brief description of each method and any necessary deviations from the procedures outlined in the QAPP are provided in the following section.

6.1.2.1 Modified Method 5 (MM5).

Gas sampling for dioxins and furans was conducted according to the October 1984 draft of the ASME chlorinated organic compound sampling protocol.

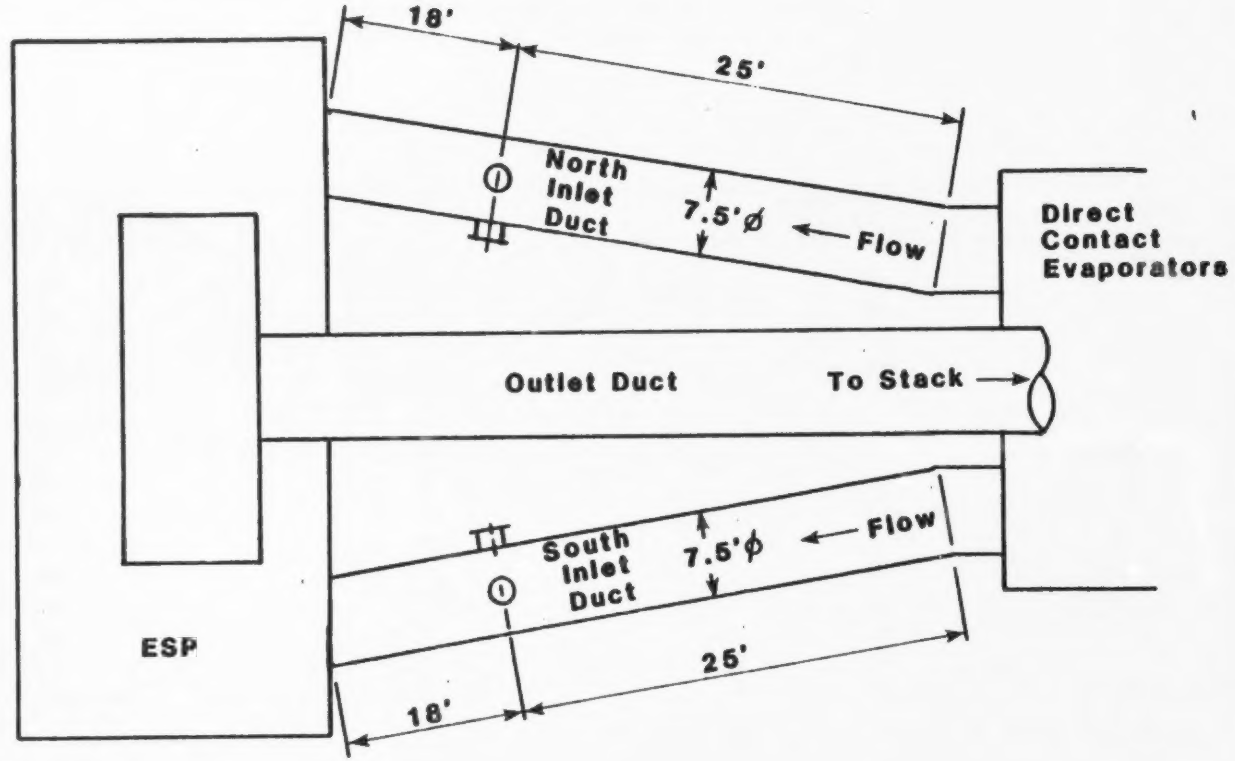
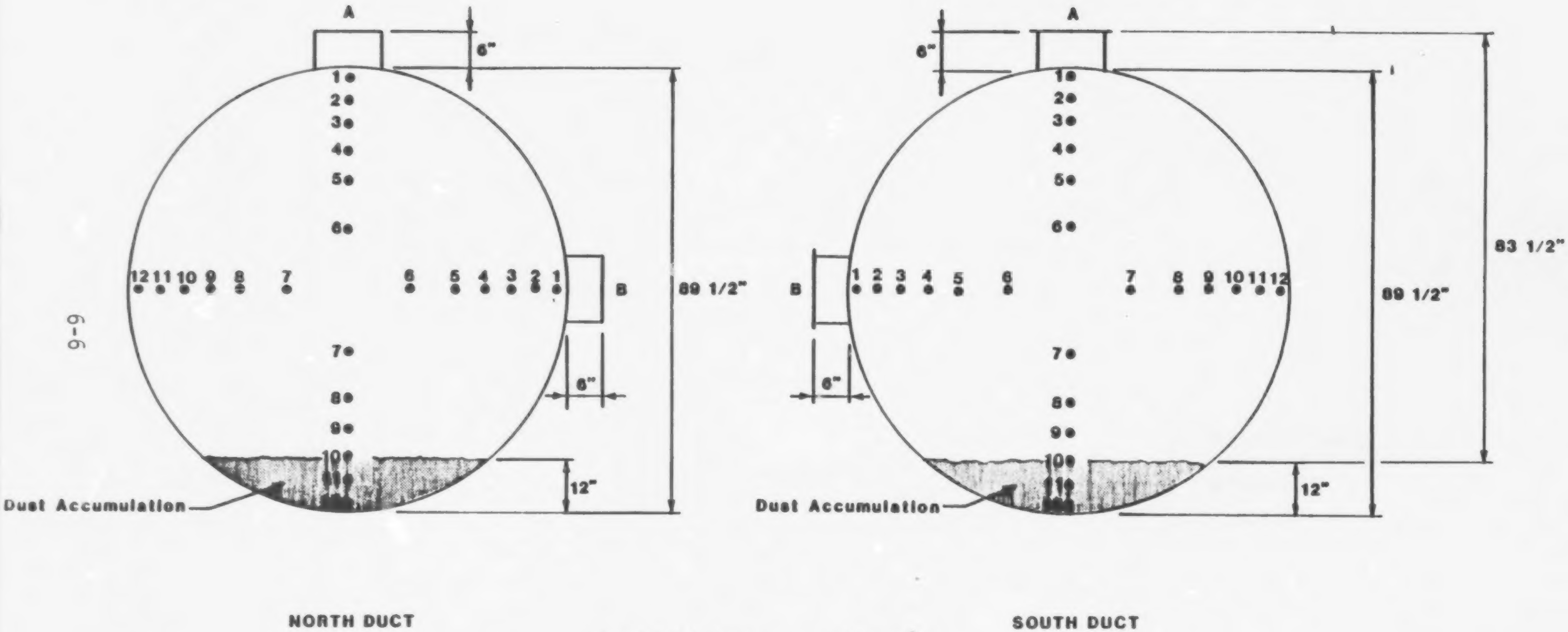


Figure 6-3. ESP Inlet Sample Port Location, Site BLB-B



Total Duct Area = 6291 in^2
Accumulation Area = 508 in^2
Blockage = 8.0 %

Figure 6-4. Sample Point Layout, ESP Inlet Ducts, Site 05.

TABLE 6-1. SUMMARY OF GAS SAMPLING METHODS FOR SITE 05

Sample Location	Sample Type or Parameter	Sample Collection Method
ESP Outlet, Point E, Figure 4-1	Dioxin/furan	Modified EPA Method 5
	Volumetric Flow	EPA Method 2
	Gas Molecular Weight	EPA Method 3
	Moisture	EPA Method 4
	HCl	HCl train
ESP Inlet, Point D, Figure 4-1		
South Duct	Dioxin/furan	Modified Method 5
	Volumetric flow	EPA Method 2
	Molecular Weight	EPA Method 3
	Moisture	EPA Method 4
North Duct	Volumetric flow	EPA Method 2
Recovery Boiler Outlet, Point C, Figure 4-1	CO, CO_2, O_2, SO_2, NO_x and THC monitoring	Continuous monitors

Minor deviations from the ASME protocol are discussed later in this section. This sampling method is a modified version of EPA Method 5 that includes a solid sorbent module for trapping vapor phase organics. The MM5 sampling train was used to collect samples at the electrostatic precipitator outlet exhaust stack and at the black liquor boiler outlet sampling location. Following sample recovery, the various parts of the sample (filter, solvent rinses, sorbent trap, etc.) were sent to the EPA's Troika laboratories to quantify 2, 3, 7, 8-TCDD, tetra-through octa-dioxin homolgues, 2,3,7,8-TCDF, and tetra- through octa- furan homologues. A total of three MM5 test runs were conducted simultaneously at the two sampling locations, with one test run being conducted at each location per test day. The MM5 samples were collected isokinetically over a 240-minute on-line sampling period at the electrostatic precipitator outlet with a sample flow rate of approximately 0.50 scfm. Sampling was performed during the same time period at the electrostatic precipitator inlet location. The actual on-line sampling period was 160-200 minutes. Multiple filter changes were required at this location because of the high particulate loading. A complete traverse was not completed during Run 01. The sample box suspension system failed after the top three points on the vertical diameter were sampled. The probe was bent and a replacement was not readily available. The sampling train was successfully leak checked after the partial traverse. The sample flow rate at the electrostatic precipitator inlet was approximately 0.5 scfm.

A schematic diagram of the MM5 sampling train is shown in Figure 6-5. Flue gas is pulled from the stack through a nozzle and a heated glass probe. Particulate matter is removed from the gas stream by means of a glass fiber filter housed in a teflon-sealed glass filter holder maintained at 248 ± 25^{o}F. The gas passes through a sorbent trap similar to that illustrated in Figure 6-6 for removal of organic constituents. The trap consists of separate sections for (1) cooling the gas stream, and (2) adsorbing the organic compounds on Amberlite XAD-2^{R} resin (XAD). A chilled impinger train following the sorbent trap is used to remove water from the flue gas, and a dry gas meter is used to measure the sample gas flow.

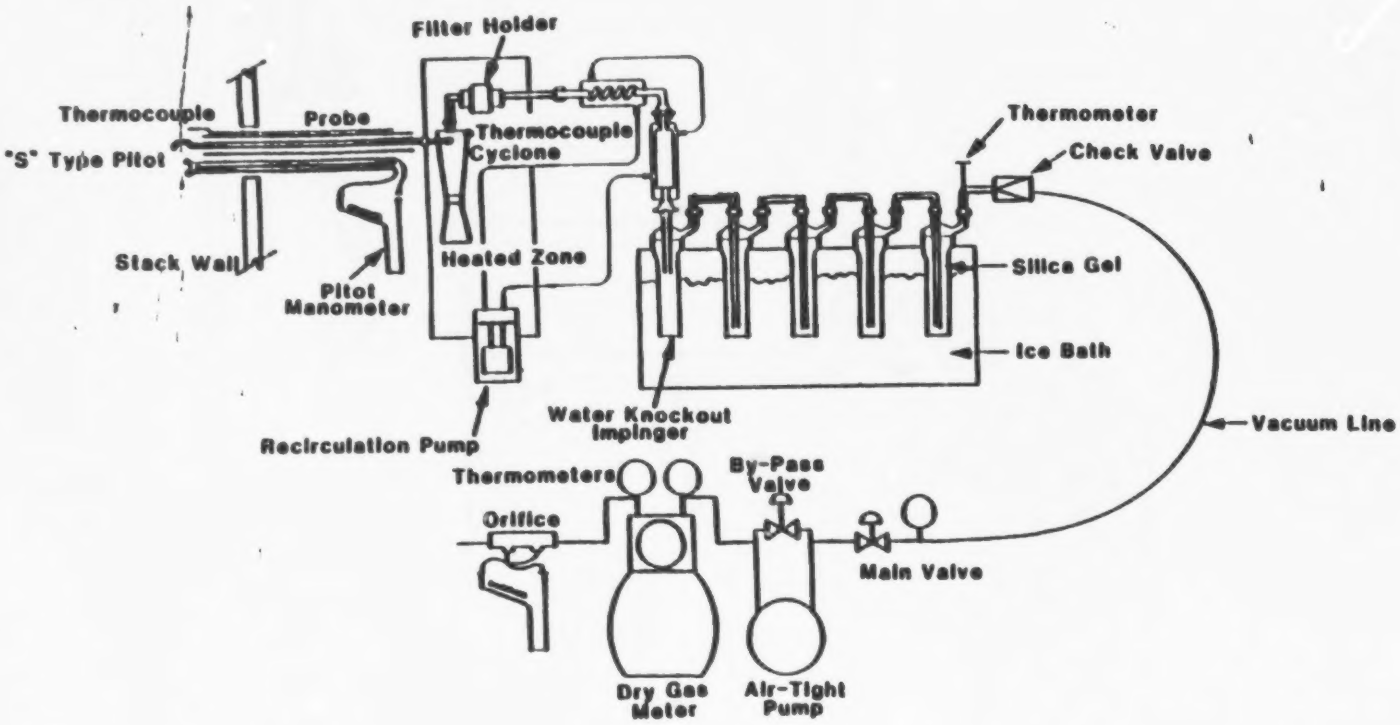


Figure 6-5: Modified Method 5 Train

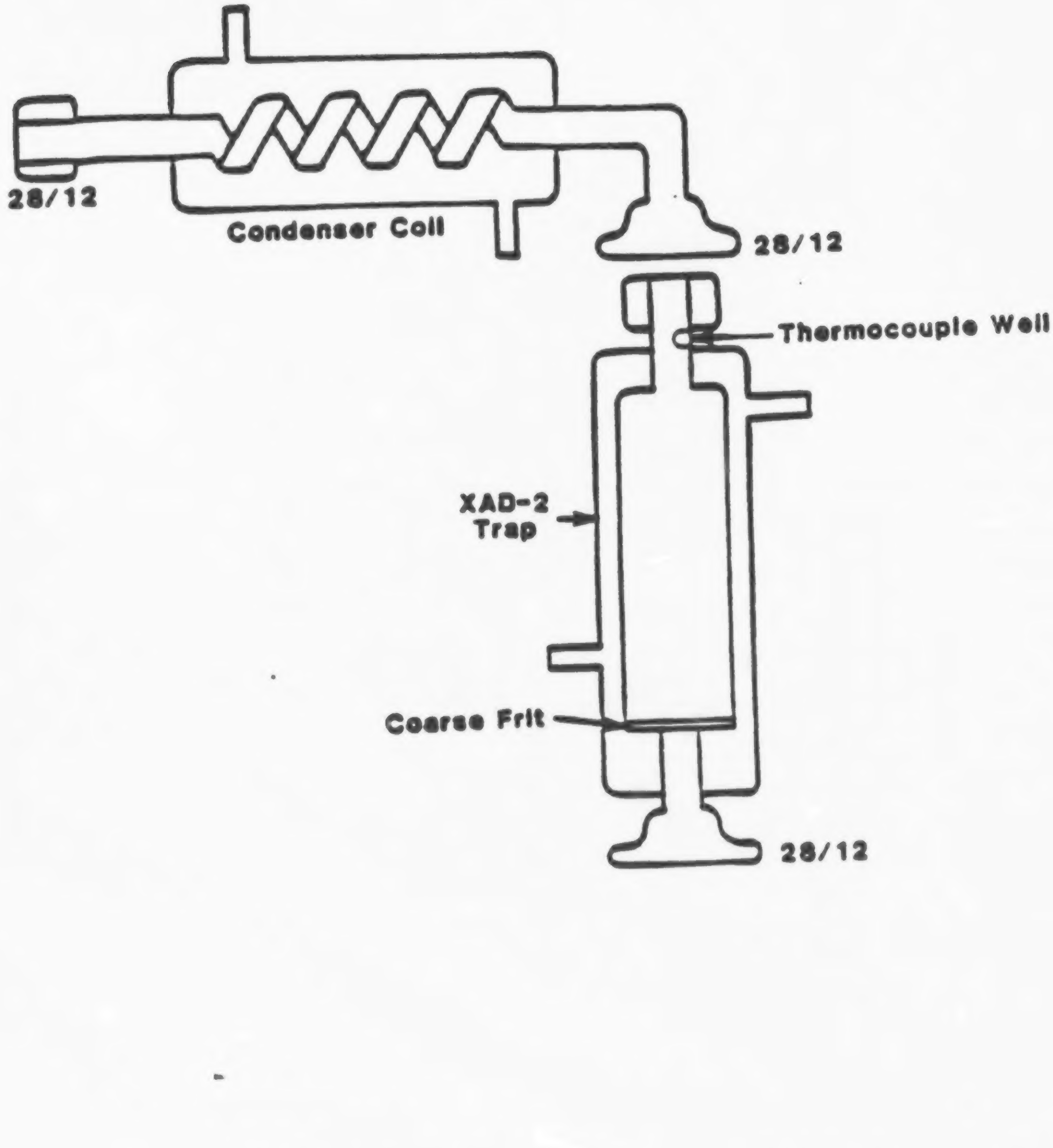


Figure 6-6: Adsorbent Sampling System

Modifications to the ASME protocol that were instituted for this test site include the following:

1. Sample recovery was modified to include methylene chloride in the sample train rinsing scheme. Water, acetone, and methylene chloride were used in series to recover the probe, back half-coil, and first impinger samples. Previous black liquor sampling experience has shown that water is necessary because the black liquor boiler particulate is soluble in water but insoluble in acetone.
2. The probe brush is specified in the ASME protocol as being inert material with a stainless steel handle. To ensure cleanliness, a separate precleaned nylon bristle brush attachable to a stainless steel handle was used for each probe cleaning.
3. The condenser was oriented horizontally instead of vertically.

6.1.2.2 HCl Determination.

HCl concentrations in the electrostatic precipitator outlet exhaust stack were determined using another modification fo EPA Method 5. The sample train components and operation were identical to those of Method 5 with the following exceptions:

1. No knockout impinger was utilized.
2. Water in the first two impingers was replaced with 0.1M KOH. As discussed in Section 4.1, the substitution of KOH in the impingers was performed to eliminate NaCl interferences in the determination of HCl emissions by utilizing sodium, sulfate, carbonate and chloride material balances on the impinger solutions. These interferences would lead to overestimates of HCl due to the chlorine from NaCl. Upon further study of this issue, it was determined that several additional chemical analysis would be needed to remove the potential NACl interference. The uncertainty of the final result would be increased according to the uncertainty of each additional analysis. As a result, the plan to remove NaCl interferences was dropped and only the total chloride analysis results are reported.
3. Sampling was single-point isokinetic with the nozzle placed at points in the stack with approximate average velocity.

4. The moisture/KOH in the impingers was saved for laboratory analysis by ion chromatography for total chlorides. The impinger catch was analyzed by Radian's Austin, Texas laboratory.

Recovery of the HCl train provided a sample consisting of three components: probe rinse, filter, and back-half rinse/impinger catch.

A total of three HCl train runs were performed at the electrostatic precipitator outlet stack sampling location. The HCl samples were collected over on-line sample times of 100 to 175 minutes at a sample flow rate of approximately 0.4 scfm.

6.1.2.3 Volumetric Gas Flow Rate Determination.

The volumetric gas flow rate was determined at the electrostatic precipitator inlet (corrected for one partially blocked duct, see Appendix L) and outlet sampling locations using EPA Method 2. Based on this method, the volumetric gas flow rate was determined by measuring the average velocity of the flue gas and the cross-sectional area of the duct. The average flue gas velocity was calculated from the average of the velocity pressure differential (P) measurements at each traverse point, the average flue gas temperature, the gas molecular weight, and the absolute static pressure.

6.1.2.4 Flue Gas Moisture Determination.

The moisture content of the flue gas was determined at the electrostatic precipitator inlet and outlet sampling locations using EPA Method 4. Based on this method, a measured volume of particulate-free gas was pulled through a chilled impinger train. The quantity of condensed water was determined gravimetrically and then related to the volume of gas sampled to determine the moisture content.

6.1.2.5 Flue Gas Molecular Weight Determination.

The integrated sampling technique described in EPA Method 3 was used at the electrostatic precipitator inlet and outlet sampling locations to obtain a composite flue gas sample for fixed gas (O_2, CO_2, N_2) analysis. The fixed gas analysis was used to determine the molecular weight of the gas stream. A small diaphram pump and a stainless steel probe were used to extract single point flue gas samples. The samples were collected in a Tedlar^R bag. Moisture was removed from the gas sample by a water-cooled condenser so that the fixed gas analysis is on a dry basis.

The composition of the gas sample was determined using a Shimadzu Model 3BT analyzer instead of the Fyrite or Orsat analyzer prescribed in EPA Method 3. The Shimadzu instrument employs a gas chromatograph and a thermal conductivity detector to determine the fixed gas composition of the sample.

6.1.2.6 Continuous Monitors.

Continuous monitoring was performed at the boiler outlet sampling location for O_2, CO_2, CO, NO_x, SO_2, and THC throughout the 4 to 6-hour period that MM5 dioxin sampling was being conducted each test day. The primary objectives of the continuous monitoring effort were to observe fluctuations in flue gas parameters and to provide an indication of combustion conditions. sample acquisition was accomplished using an in-stack filter probe and a 150 ft. length of heat-traced Teflon^R sample line connected to a mobile laboratory. The heat-traced sample line was maintained at a temperature of at least 120^{0}C to prevent condensation in the sample line. The stack gas sample was drawn through a sample gas conditioner, which consisted of an ice bath and a knockout trap. The sample gas conditioner removes moisture and thus provide a dry gas stream for analysis. A separate unconditioned gas stream was supplied to the THC analyzer for analysis on a wet basis.

An Anarad Model 412 nondispersive infrared (NDIR) analyzer was used to measure CO and CO_2; a Beckman Model 755 paramagnetic analyzer was used to measure O_2; a Teco Model 10 chemiluminescent analyzer was used to measure NO_x; a Teco Model 40 pulsed fluorescence analyzer was used to measure SO_2; and a Beckman Model 402 flame ionization analyzer was used to measure THC.

6.2 LIQUID SAMPLING

Five types of liquid samples were obtained during this test program: strong black liquor, weak black liquor, white liquor, spent acid from the R2 ClO_2 generator, and well-water. The corresponding sampling locations are shown in Figure 4-1 as A, J, G, I, and H, respectively.

6.2.1 Strong Black Liquor Sampling

Strong black liquor samples were taken from a sample tap in a pressure line to one of the black liquor firing guns in the furnace. The host site performs strong black liquor sampling at this location.

Three identical composite strong black liquor samples were obtained during each of the three tests: a 1 liter composite was shipped to Troika for dioxin precursor analysis, and 125 ml composite was analyzed for dioxin precursors by Radian/RTP. The composite strong black liquor samples for each run were comprised of hourly 1-liter grab samples from a line loading to the black liquor firing guns. The hourly grab samples were placed into a heated jar to prevent the sample from solidifying prior to taking the final sample aliquots. This was accomplished by wrapping the sample composite bottle with rubber coated heat tape.

6.2.2 Auxiliary Black Liquor Circuit Sampling

Samples of the white liquor, weak black liquor, well water and spent acid from the R2 ClO_2 generator were obtained to indicate the relative amounts of chlorine entering the black liquor circuit through various input sources. One 125 ml composite sample of each stream was obtained during each test. Individual samples were taken twice during each test run, and the composite samples were prepared accordingly. The samples were analyzed for total chlorine content only. The chlorine content data was used in conjunction with mass flow data to determine the relative amounts of chlorine associated with each potential source of chlorine input to the black liquor circuit. The chlorine analysis was perfromed by the Radian Analytical Services laboratory in Austin, Texas using ion chromatography.

The weak black liquor samples were collected from a sample tap in the transfer line between the weak black liquor storage tank and the vacuum evaporators. The white liquor was collected from a sample tap on the transfer line from the storage tank to the digestors. The R2 ClO_2 generator spent acid was collected from a sample tap in the line from the ClO_2 generation plant to the weak black liquor storage tank. The process makeup water was sampled from taps at the two wells (North and South) serving the plant.

6.3 SOLID SAMPLING

Two types of solid samples were obtained at Site BLB-B: by-product saltcake from the R3 ClO_2 generation process and soils from plant property. The sampling locations and methods are discussed below.

6.3.1 By-Product Saltcake Sampling

Samples of by-product saltcake from the R3 generation system were collected from the vacuum filter belt. A single grab sample was collected once per test run. Access to the sampling area was limited because of elevated ambient chlorine concentrations. A 125 gram aliquot of the grab sample was sent to Radian's Austin Laboratory for total chlorine analysis.

6.3.2 Soil Sampling

A single composite soil sample comprised of 10 individual soil samples was obtained at Site BLB-B. Soil sampling protocol for Tiers 3, 5, 6, and 7 of the National Dioxin Study are specified in the document, "Sampling Guidance Manual for the National Dioxin Study." A similar protocol was used for soil sampling at this test site. A total of 10 soil sampling locations were selected on plant property surrounding the black liquor boiler complex. The 10 individual soil sampling locations are shown in Figure 6-7 and are listed in Table 6-2. Soil samples were collected by forcing a bulb planter into the soil to a depth of 3 inches. The soil samples were then composited in a clean stainless steel bucket. Five hundred grams of the composite was placed in a 950 ml amber glass bottle and returned to Radian/RTP for archiving.

TABLE 6-2. DESCRIPTION OF SOIL SAMPLING LOCATIONS AT SITE 05

Aliquot Number	Location Description
1	River bank at North end of plant
2	Near Plant gate
3	Behind administration buildings
4	Dirt beside road at Biceps
5	Dirt beside road at maintenance area
6	Dirt near wastewater clarifier
7	Dirt beside road near clarifier
8	Dirt beside road south of #3 machine room
9	Dirt beside road to water wells
10	River bank at south end of plant

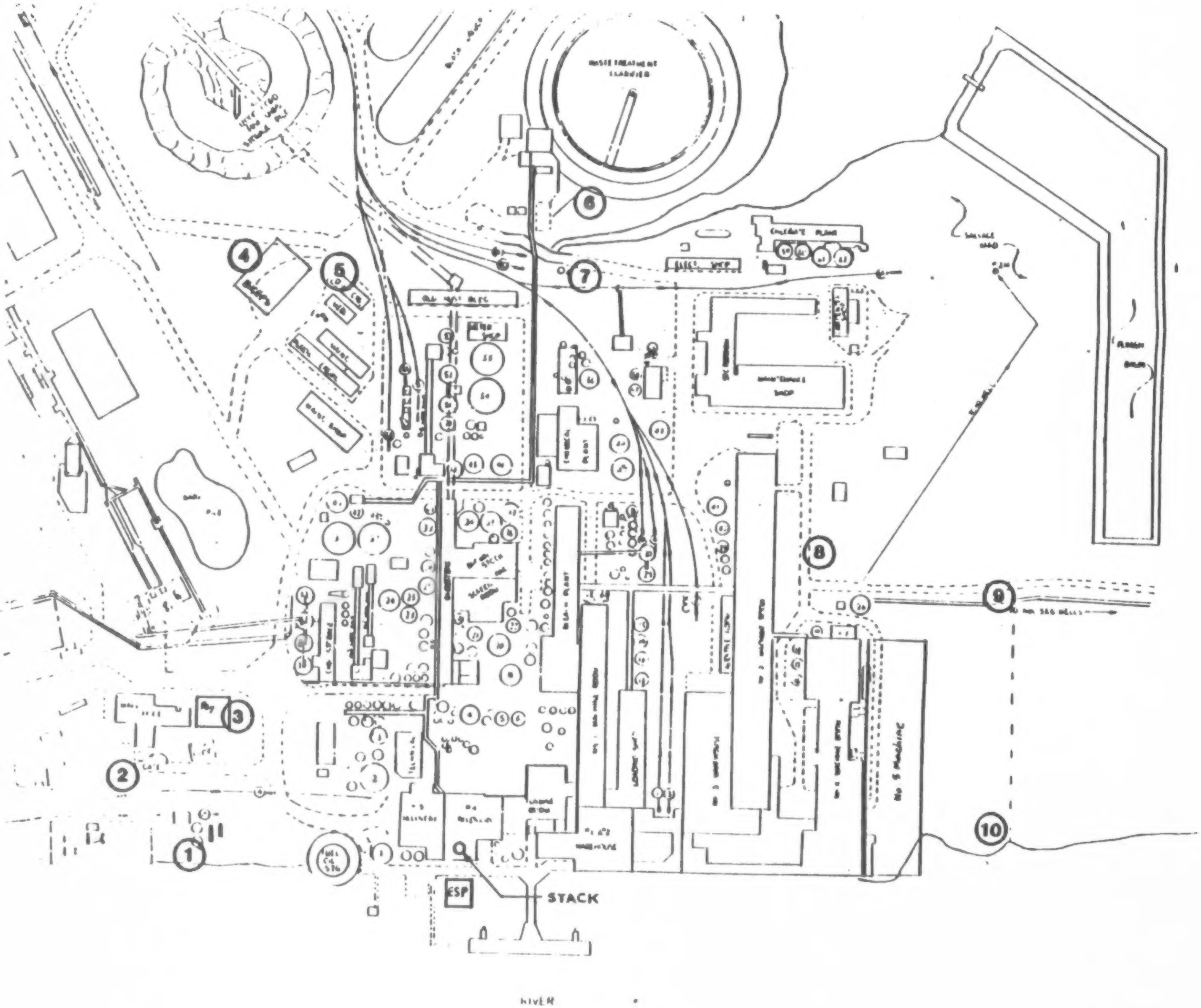


Figure 6-7. Soil Sampling Locations, Site 05.

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7.0 ANALYTICAL PROCEDURES

Laboratory procedures used to quantify dioxins/furans and dioxin/furan precursors in the Tier 4 samples are described in this section. Analyses for dioxins/furans were performed by EPA's Troika laboratories. The procedures used for these analyses are described in detail in the Analytical Procedures and QA Plan for the Analysis of Tetra through Octa CDD's and CDF's in Samples from Tier 4 Combustion and Incineration Processes (addendum to EPA/600/3-85-019, April 1985) and are summarized in Section 7.1.

Black liquor boiler feed samples from Site BLB-B were analyzed to determine concentrations of chlorinated phenols (CP), chlorobenzenes (CB), polychlorinated biphenyls (PCBs), total organic halogen (TOX), and total chlorine. Procedures used for these analyses are detailed in Section 7.2.

7.1 DIOXINS/FURANS

The analytical procedures described in this section were used for the determination of PCDD and PCDF in stack effluent samples (MM5). Samples consisting of organic solvents, aqueous solutions and solids were prepared for analysis using slightly different procedures. The organic solvent samples consisted of rinses from the MM5 probe, nozzle, filter housing and condenser coil. Aqueous solutions consisted of impinger catch and solid samples including filters and XAD resin. Isotopically-labeled surrogate compounds were added to all samples prior to extraction to allow determination of method efficiency.

Organic liquid samples (acetone and hexane or methylene chloride) were concentrated using a nitrogen blowdown apparatus. The residue, which contained particulates from the train probe and nozzle, was combined with the filter and handled as a solid sample. Solid samples were extracted with benzene in a Soxhlet apparatus for a period of at least 16 hours. The sample was then concentrated by nitrogen blowdown and subjected to chromatographic cleanup procedures.

Aqueous solutions were extracted with hexane by vigorous shaking for a three hour period. This extraction procedure was repeated three times, with the organic fractions ultimately being combined and concentrated for chromatographic cleanup.

The cleanup procedure involved using liquid chromatographic columns to separate the compounds of interest from other compounds present in the samples. Four different types of columns were used: a combination acid and base modified silica gel column, a basic alumina column, a PX-21 carbon/celite 545 column and a silica/diol micro column. These were used in successive steps, with the last two being used only if necessary.

The cleaned samples were analyzed using high resolution gas chromatography/high resolution mass spectrometry (GC/MS). Conditions for the analyses were as follows:

Gas Chromatograph - Injector configured for capillary column, splitless injection; injector temperature 280°C; helium carrier gas at 1.2 mL/min; initial column temperature 100°C: final column temperature 240°C; interface temperature 270°C.

Mass Spectrometer - Varian/MAT Model 311A; electron energy 70ev; filament emission 1mA; mass resolution 8,000 to 10,000; ion source temperature 270°C.

7.2 DIOXIN/FURAN PRECURSORS

Feed samples for Site BLB-B were analyzed by Radian/RTP for chlorophenols (CP), chlorobenzenes (CB) and polychlorinated biphenyls (PCBs) by GC/MS; total organic halides (TOX) by GC/Hall detector; and total chlorine by Parr Bomb combustion followed by ion chromatography. Analytical procedures are discussed in the following sections.

7.2.1 GC/MS Analyses

The analytical procedures used for determining CP, CB, and PCB concentrations in feed samples are modified versions of procedures typically used for the analysis of MM5 train components.

7.2.1.1 Sample Preparation

A flow chart for the sample preparation procedure used for Site BLB-B feed samples is shown in Figure 7-1. The first step involved adding 200 mL of methanol to the sample. The next step in the procedure involved adding labeled surrogate compounds to provide a measure of extraction method efficiency and sonicating the sample for 30 minutes. The sonicated sample was filtered and rinsed with 85 mL $MeCl_2$ and distilled H_2O. The filtrate was extracted three times with 50 mL $MeCl_2$ in a separatory funnel and the resulting aqueous and organic fractions saved for derivatization and/or further cleanup. Cleanup procedures consist of initial extraction of the sample with an appropriate solvent, preliminary separation of the compounds of interest by solvent partitioning and liquid chromatography, and analysis of the processed fractions. Solutions containing CB and PCB are injected directly into the GC/MS, and solutions containing CP are derivatized prior to injection. Details on the procedures used for Site 05 samples are provided in the sections below.

The aqueous fraction (or acids portion) was acidified to pH #2 with HCl and then extracted three times with $MeCl_2$, then two times with $NaHCO_3$. The $MeCl_2$ from this extraction was dried with anhydrous Na_2SO_4, exchanged to benzene, and concentrated using a nitrogen blowdown apparatus. Acetylation of any CP present in the sample involved the following steps:

1. Add 2.0 mL isooctane, 2.0 mL acetonitrile, 50 uL pyridine, and 20 uL acetic anhydride to the extract. Put the test tube containing the extract in a 60^oC water bath for 15 minutes, shaking 30 seconds every 2 minutes.
2. Add 6 mL of 0.01 N H_3PO_4 to the test tube and agitate the sample for 2 minutes on a wrist action shaker.
3. Remove the organic layer and add the quantitation standard. Concentrate the sample in a Reacti-Vial^R at room temperature (using prepurified N_2) to 1 mL prior to GC/MS analysis.

Cleanup of the organic (or base/neutrals) layer from the initial $MeCl_2$ extraction involved successively washing the extract with concentrated H_2SO_4 and deionized water. The acid or water was added in a 30 mL portion and the sample was shaken for two minutes. After the aqueous and organic layers were completely separated, the aqueous or acid layer was discarded.

The acid washing procedure was repeated until the acid layer was colorless. The sample was then dried with anhydrous Na_2SO_4, exchanged into hexanes and concentrated. Final cleanup of the sample by column chromatography involved the following procedure.

A glass macro-column, 20 mm o.d. x 230 mm in length, taper to 6 mm o.d. on one end was prepared. The column was packed with a plug of silanized glass wool, followed successively by 1.0 g silica, 2.0 g silica containing 33% (w/w) 1 M NaOH, and 2.0 g silica. The concentrate was quantitatively transferred to the column and eluted with 90 mL hexanes. The entire eluate was collected and concentrated to a volume of 1 mL in a centrifuge tube, as above.

A disposable liquid chromatography mini-column was constructed by cutting off a 5-mL Pyrex disposable pipette at the 2.0 mL mark and packing the lower portion of the tube with a small plug of silanized glass wool, followed by 1 g of Woehlm basic alumina, which has been previously activated for at least 16 hours at 600°C in a muffle furnace and cooled in a desiccator for 30 minutes just before use. The concentrated eluate from above was quantitatively transferred onto the liquid chromatography column, and the centrifuge tube was rinsed consecutively with two 0.3-mL portions of a 3 percent $MeCl_2$:hexanes solution, and the rinses were transferred to the chromatography column.

The column was eluted with 20 mL of a 50 percent (v/v) $MeCl_2$:hexanes, and the elute was retained. The retained fraction was concentrated to a volume of approximately 1 mL by heating the tubes in a water bath while passing a stream of prepurified N_2 over the solutions. The quantitation standard was added and the final volume was adjusted to 1.0 mL prior to GC/MS analysis.

7.2.1.2 Analysis

Analyses for CP, CB and PCBs present in the feed sample extracts were performed using a Finnigan Model 5100 mass spectrometer using selected ion monitoring. A fused silica capillary column was used for chromatographic separation of the compounds of interest. Analytical conditions for the GC/MS analysis are shown in Table 7-1.

Tuning of the GC/MS was performed daily as specified in the Tier 4 QA Project Plan. An internal standard calibration procedure was used for sample quantitation. Compounds of interest were calibrated against a fixed

TABLE 7-1. INSTRUMENT CONDITIONS FOR GC/MS PRECURSOR ANALYSES

Parameter	Chlorobenzenes/ Polychlorinated biphenyls	Chlorophenols
Column	30 m WB DB-5 (1.0 u film thickness) fused silica capillary	
Injector Temperature	290°C	290°C
Separator Oven Temperature	290°C	290°C
Column Head Pressure	9 psi	9 psi
He flow rate	1 mL/min	1 mL/min
GC program	40(4)-290°C, 10°/min & hold	40(1)-290°C, 12°/min & hold
Emission Current	0.50 mA	0.50 mA
Electron Energy	70 eV	70 eV
Injection Mode	Splitless 0.6 min, then 10:1 split	
Mode	Electron ionization, Selected Ion Monitoring	

concentration of either d_{12}-chrysene (CB, PCB) or d_8-naphthalene (CP). Compounds of the calibration solution are shown in Table 7-2. For multi-point calibrations, this solution was injected at levels of 10, 50, 100, and 150 ng/mL.

Compound identification was confirmed by comparison of chromatographic retention times and mass spectra of unknowns with retention times and mass spectra for reference compounds. Since the selected ion monitoring technique was necessary for the types of samples analyzed, care was taken to monitor a sufficiently wide mass region to avoid the potential for reporting false positives.

The instrument detection limit was estimated to be approximately 500 picograms on column. For a 50 g sample and 100 percent recovery of the analyte, this corresponds to a feed sample detection limit of 10 ppb.

7.3 TOX ANALYSIS

Boiler feed samples were analyzed for total organic halide (TOX) by short-column GC and a Hall detector (GC/Hall). Samples were extracted with benzene for at least 16 hours in a Soxhlet apparatus. The extracts were washed three times with 100 mL portions of reagent-grade water concentrated to 10 mL.

An attempt to use a fused silica capillary column to separate surrogates from target compounds was unsuccessful due to the complexity of the sample constituents. Determinations for TOX were therefore performed on samples without surrogates and no measure of extraction efficiency is available.

Instrument conditions are shown in Table 7-3. Sample quantitation was based on an average response factor developed from a mixture of chlorinated benzenes and brominated biphenyls. Individual CP, CB and PCBs were also injected at various concentrations to develop a calibration curve for comparison to the mixture response factors.

7.4 TOTAL CHLORINE ANALYSIS

Total chlorine concentrations in feed samples were determined by Parr Bomb combustion followed by ion chromatography (IC). A 0.5g sample was placed

TABLE 7-2. COMPONENTS OF THE CALIBRATION SOLUTION

Base/Neutrals	Acids
4-chlorobiphenyl	2,5-dichlorophenol
3,3'-dichlorobiphenyl	2,3-dichlorophenol
2,4',5-trichlorobiphenyl	2,6-dichlorophenol
3,3'4,4'-tetrachlorobiphenyl	3,5-dichlorophenol
2,2',6,6'-tetrachlorobiphenyl	3,4-dichlorophenol
2,2,4,5,6-pentachlorobiphenyl	2,3,5-trichlorophenol
2,2',4,4',5,5'-hexachlorobiphenyl	2,3,6-trichlorophenol
2,2',3,4,4',5',6-heptachlorobiphenyl	3,4,5-trichlorophenol
2,2',3,3',4,4',5,5'-octachlorobiphenyl	2,4,5-trichlorophenol
2,2',3,3',4,4',5,6,6'-nonachlorobiphenyl	2,3,4-trichlorophenol
decachlorobiphenyl	2,3,5,6-tetrachlorophenol
p-dichlorobenzene	pentachlorophenol
1,2,4-trichlorobenzene	d_6-phenol (SS)
1,2,3,5-tetrachlorobenzene	d_4-2-chlorophenol (SS)
pentachlorobenzene	$^{13}C_6$-pentachlorophenol (SS)
hexachlorobenzene	d_8-naphthalene (QS)
d_4-1,4-dichlorobenzene (SS)[1]	2,4,6-tribromophenol (QS)
3-bromobiphenyl (SS)	d_{10}-phenanthrene (QS)
2,2',5,5'-tetrabromobiphenyl (SS)	d_{12}chrysene (QS)
2,2',4,4',6,6'-hexabromobiphenyl (SS)	
octachloronaphthalene (QS)[2]	
d_{10}-phenanthrene (QS)	
d_{12}-chrysene (QS)	

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[1] Surrogate standard.

[2] Quantitation standard.

TABLE 7-3. ANALYTICAL CONDITIONS FOR TOX ANALYSIS

Hall Detector Conditions

Reactor temperature - 850°C
Solvent - n-propanol
Hydrogen flow rate - 35 mL/min

GC Conditions (Varian 3700)

Injection volume (1 - 5 uL)
Helium carrier gas flow rate - 60 mL/min
Column - 3-ft packed column with 1 in 10% OV 101
Column temperature - 200°C isothermal

in the Parr Bomb with 10 mL of a 50 g/L Na_2CO_3 solution. After combustion of the samples according to standard procedures (ASTM 2015), the contents of the bomb were rinsed into a 100 mL flask and diluted to 100 mL. The resulting solution was analyzed for chloride concentration (Cl^-) by IC using standard anion conditions. For samples difficult to combust (such as sludges), 25 drops of paraffin oils were added to the bomb prior to combustion.

8.0 QUALITY ASSURANCE/QUALITY CONTROL (QA/QC)

This section summarizes the results of the quality assurance and quality control (QA/QC) activities for Site BLB-B. The flue gas dioxin/furan data for this site were generally within the QC specifications presented in the Tier 4 QAPP. All of the surrogate recoveries for labeled TCDD's were within the specified limits of 50 to 120 percent. Run 03 (ESP inlet sample) was the only sample having surrogate recoveries outside the QC limits of 40 to 120 percent for hepta- and octa-CDD's. The results of the analysis of the fortified laboratory QC sample were all within 25 percent of the true value, which is well within the Tier 4 objective of ±50 percent. These data indicate that the dioxin/furan results are within accuracy criteria specified for Tier 4.

The dioxin/furan precursor analysis of the feed samples was not as accurate as the dioxin/furan homologue analysis. Surrogate recoveries of the base neutrals fraction were generally within the specified QC limits of ±50 percent; however, the surrogate acid fractions were generally below the specified limits. In spite of the low recoveries of the acid fraction, the dioxin/furan precursor results are considered a reasonable approximation of the true precursor concentration in the feed samples.

The following sections summarize the results of all Site BLB-B QA/QC activities. Manual gas sampling methods are considered in Section 8.1 and continuous emission monitoring and molecular weight determinations are considered in Section 8.2. The laboratory analysis QA/QC activities are summarized in Section 8.3.

8.1 MANUAL GAS SAMPLING

Manual gas sampling methods used at Site BLB-B included Modified Method 5 (MM5), the HCl acid train and EPA Methods 1 through 4. These methods are discussed in Section 6.0. Quality assurance and quality control (QA/QC) activities for the manual methods centered around 1) equipment calibration, 2) glassware precleaning, 3) procedural QC checks, and 4) sample custody procedures. Key activities and QC results in each of these areas are discussed in this section. Also discussed are problems encountered that may have affected data quality.

8.1.1 Equipment Calibration and Glassware Preparation

Pretest calibrations or inspections were conducted on pitot tubes, sampling nozzles, temperature sensors and analytical balances. Both pre- and post-test calibrations were also performed on dry gas meters. All of this equipment met the calibration criteria specified in the QAPP. Differences in pre- and post-test dry gas meter calibrations were less than 2.5 percent.

An extensive precleaning procedure was implemented for all sample train glassware and sample containers. This cleaning procedure, which is outlined in Table 8-1, was implemented to minimize the potential for sample contamination with substances that could potentially interfere with the analysis for dioxins and furans. To minimize the potential for contamination in the field, all sample train glassware was kept capped until use and a controlled environment was maintained in the recovery trailer during sample train assembly and recovery.

8.1.2 Procedural QC Activities/Manual Gas Sampling

Procedural QC activities during manual gas sampling focused on:

- inspecting equipment visually;
- collecting sampling train blanks;
- ensuring the proper location and number of traverse points;
- conducting pre-test, port change, and post-test sample train leak checks;
- maintaining proper temperatures at the filter housing, sorbent trap and impinger train
- maintaining isokinetic sampling rates, and
- recording all data on preformatted data sheets.

Results of isokinetic rate calculations for the MM5 test runs are shown in Table 8-2. As shown in Table 8-2, the average isokinetic sampling rate for the MM5 sampling trains achieved the QA objective of ±10 percent for all test runs.

TABLE 8-1. GLASSWARE PRECLEANING PROCEDURE

NOTE: USE DISPOSABLE GLOVES AND ADEQUATE VENTILATION

1. Soak all glassware in hot soapy water (Alconox) 50°C or higher.
2. Distilled/deionized H_2O rinse (X3)[a].
3. Chromerge rinse, if glass, otherwise skip to 6.
4. High purity liquid chromatography grade H_2O rinse (X3).
5. Acetone rinse (X3), (pesticide grade).
6. Hexane rinse (X3), (pesticide grade).
7. Cap glassware with clean glass plugs or hexane rinsed aluminum foil.

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[a] (X3) = three times.

TABLE 8-2. SUMMARY OF ISOKINETIC RATE RESULTS FOR MM5 SAMPLING, SITE 05

Run	ESP Outlet Isokinetic Rate	Meets QC Objective?	ESP Inlet Isokinetic Rate	Meets QC Objective?
01	98.0	yes	103.9	yes
02	104.8	yes	102.8	yes
03	103.7	yes	102.6	yes

NOTE: The quality control objective for MM5 sampling was an isokinetic rate of 100 ± 10%.

8.1.3 Sample Custody

Sample custody procedures used during this program emphasized careful documentation of the samples collected and the use of chain-of-custody records for samples to be transported. Steps taken to identify and document samples collected included labeling each sample with a unique alphanumeric code and logging the sample in a master sample logbook. All samples shipped to Troika or returned to Radian were also logged on chain-of-custody records that were signed by the sampler at shipment and then by the receiving laboratory when the samples arrived. Each sample container was also sealed with chain-of-custody seal so that the container could not be opened without tearing the seal.

8.2 CONTINUOUS MONITORING/ MOLECULAR WEIGHT DETERMINATION

Flue gas parameters measured continuously at the Inlet Location during the MM5 test runs include CO, CO_2, O_2 total hydrocarbons (THC), SO_2, and NO_x. The concentrations of O_2, CO_2 and nitrogen (N_2) were also determined for integrated bag samples of the flue gas. Quality control results for these analyses are discussed in this section.

Drift check results for the continuously monitored flue gas parameters are summarized in Table 8-3. Data reduction was performed by assuming a linear drift of the instrument response over the test day based on drift checks at the beginning and end of the day. The largest calibration drifts were observed for the SO_2 analyzer, but none exceeded QC target goals. The smallest instrument drift was observed in the oxygen monitor.

The quality control standards for this program consisted of mid-range concentration standards that were intended for QC purposes and not for instrument calibration. The QC gases were analyzed immediately after calibration each day to provide data on day-to-day instrument variability. The acceptance criteria for the analysis of each QC standard was agreement within ±10 percent of the running mean value. The CEM data quality was good for all constituents except O_2. The rest of the CEM data is accurate and valid for Tier 4 parameter comparisons (accurate, reproducible measurements were made of what existed after the sample conditioning system leak).

TABLE 8-3. SUMMARY OF DRIFT CHECK AND CONTROL STANDARD RESULTS

Test Date	Test Run	Parameter	Drift Check Input Concentration	Drift Check Instrument Drift, %	Meets QC?	QC Standard Input Concentration	QC Standard Output Concentration	Difference From Running Mean, %	Meets QC?
2/26/85	01	02	21.2% V	-0.28	Yes	9.55% V	9.70	-	Yes
2/27/85	02	02	21.2% V	-	-	9.55% V	9.60	0.52	Yes
2/28/85	03	02	21.2% V	-0.08	Yes	9.55% V	9.50	1.05	Yes
2/26/85	01	CO	5430 ppmv	5.7	Yes	2060.0 ppmv	2316.7	-	Yes
2/27/85	02	CO	5430 ppmv	-	-	2060.0 ppmv	2382.1	-1.37	Yes
2/28/85	03	CO	5430 ppmv	-2.18	Yes	2060.0 ppmv	2463.6	-3.09	Yes
2/26/85	01	CO2	17.6% V	1.1	Yes	12.8% V	12.7	-	Yes
2/27/85	02	CO2	17.6% V	-	-	12.8% V	13.9	-4.32	Yes
2/28/85	03	CO2	17.6% V	-2.93	Yes	12.8% V	13.0	1.54	Yes
2/26/85	01	SO2	958 ppmv	-4.7	Yes	239.0 ppmv	256.8	-	Yes
2/27/85	02	SO2	958 ppmv	-	-	239.0 ppmv	250.0	1.36	Yes
2/28/85	02	SO2	958 ppmv	-5.54	Yes	239.0 ppmv	255.3	-0.51	Yes
2/26/85	01	NOx	1052 ppmv	-3.6	Yes	157.0 ppmv	165.6	-	Yes
2/27/85	02	NOx	287 ppmv	-	-	157.0 ppmv	161.5	1.30	Yes
2/28/85	03	NOx	287 ppmv	-3.22	Yes	157.0 ppmv	154.1	4.08	Yes
2/27/85	01	THC	444 ppmv	0.51	Yes	60.3 ppmv	59.5	-	Yes
2/28/85	02	THC	444 ppmv	-	-	60.3 ppmv	60.4	-0.66	Yes
2/28/85	03	THC	444 ppmv	-0.70	Yes	60.3 ppmv	67.9	-7.81	Yes

a. Instrument drift is defined as the percent difference between the instrument response to the input concentration at the beginning and end of the test run.

b. QC criteria was instrument drift within +/- 10 percent.

c. QC criteria was output concentration within +/- 10 percent of the running mean concentration for this test site.

d. Not available due to instrument malfunction.

Molecular weight was determined by analyzing integrated bag samples of flue gas for O_2, CO_2 and N_2. Quality control for this analysis involved duplicate analyses of calibration gases immediately before and after sample analysis. Analysis of the calibration gases was repeated until two consecutive analyses within ±5 percent were obtained. This same criteria of ±5 percent applied to duplicate analyses required for sample quantification. These criteria were met for all molecular weight determination.

8.3 LABORATORY ANALYSIS

QA/QC activities were carried out for dioxin/furan, precursor, and total chloride analyses performed on Site BLB-B samples. The dioxin/furan analyses of MM5 train samples performed by Troika are considered in Section 8.3.1; the precursor analyses of black liquor boiler feed samples performed by Radian/RTP are considered in Section 8.3.2; and the total chloride analyses of HCl train samples and process samples performed by Radian/Austin are considered in Section 8.3.3.

8.3.1 Dioxin/Furan Analyses

Two individual topics related to the dioxin/furan analyses at Site BLB-B are discussed in this section. Analytical recoveries of labeled surrogate compounds spiked onto MM5 train samples are reported in Section 8.3.1.1. Sample blank data are reported in Section 8.3.1.2.

8.3.1.1 Surrogate Recoveries of the Test Samples

Table 8-4 presents the analytical recovery data reported by Troika for four isotopically labeled surrogate compounds spiked onto the MM5 train samples. Samples were spiked with all four of the surrogates. Average recovery for the MM5 train samples was 75 percent for the inlet and 78 percent for the outlet.

8.3.1.2 Sample Blanks

Table 8-5 summarizes the analytical results reported by Troika for internal laboratory blanks, laboratory fortified quality control (QC) samples, proof blank MM5 train samples, and field recovery blank MM5 train samples. In

Table 8-4. Percent Surrogate Recoveries for Site BLB-B Dioxin/Furan Analyses

Sample	$^{37}Cl_4$ TCDD	$^{13}C_{12}$ TCDD	$^{37}Cl_4$ Hepta-CDD	$^{13}C_{12}$ Octa-CDD
MM5 Train Samples				
Inlet				
Run 01	96	97	55	76
Run 02	107	101	63	66
Run 03	86	80	39	28
Outlet				
Run 01	96	100	60	79
Run 02	96	77	54	64
Run 03	104	94	55	62

Table 8-5. Analysis Results for Quality Control Samples

	Flue Gas Quality Control Samples					
		Fortified Laboratory QC Sample			Field Blank MM5 Train	
Compound	Laboratory Blank	Measured Value	True Value[a,b]	Proof Blank MM5 Train	Inlet	Outlet
	Amount Detected (Nanograms per Sample)					
Dioxins						
2378 TCDD	ND	0.3	0.4 (-25)	ND	ND	ND
Other TCDD	ND	ND	ND (0)	ND	ND	ND
Penta CDD	ND	ND	ND (0)	ND	ND	ND
Hexa CDD	ND	1.5	1.6 (-6)	ND	ND	ND
Hepta CDD	ND	2.3	2.4 (-4)	ND	ND	ND
Octa CDD	ND	3.0	3.2 (-6)	ND	0.3	ND
Furans						
2378 TCDF	ND	0.4	0.4 (0)	ND	ND	ND
Other TCDF	ND	ND	ND (0)	ND	0.2	ND
Penta CDF	ND	0.5	0.8 (-37)	ND	ND	ND
Hexa CDF	ND	1.2	1.6 (-25)	ND	0.2	ND
Hepta CDF	ND	2.2	2.4 (-8)	ND	ND	ND
Octa CDF	ND	2.7	3.2 (-15)	ND	ND	ND
	Surrogate Recoveries (Percent)					
$^{37}Cl_4$-TCDD	100	88	NA	--	70	104
$^{13}C_{12}$-TCDD	102	100	NA	98	101	89
$^{37}Cl_4$-Hepta CDD	56	70	NA	--	46	67
$^{13}C_{12}$-Octa CDD	85	100	NA	75	93	91

[a] True values represent the amounts of each homologue spiked into the laboratory fortified QC samples.

[b] Value shown in parenthesis is the percentage difference between the measured and the true value:

$$\% = \frac{\text{Measured Value} - \text{True Value}}{\text{True Value}} \times 100$$

ND = Not Detected
NA = Not Applicable
TCDD = Tetra-chlorinated dibenzo-p-dioxin

general, the data showed good surrogate recoveries, with values ranging from 46 to 100 percent which satisfied the QA objectives for the project (40 to 120 percent recovery). Comparison of the measured and spiked values for the laboratory fortified QC samples showed agreement to within ±25 percent for all target species except the penta-CDF isomer. The measured value for the penta-CDF isomer was roughly 37 percent lower than the spiked value. Dioxin and furan species were non-detectable in all proof blank MM5 train samples. Small but detectable quantities of several dioxin and furan species were found in the field blank MM5 train at the ESP inlet, but were not detected in the field blank for the MM5 train at the ESP outlet. Table 8-6 gives a comparison of the dioxin/furan analytical results for the field blank MM5 train and the test run MM5 trains. For the inlet values, only the octa-CDD homologue had a detectable field blank value, equal to 19 percent of the minimum test run value. However, for the outlet data, both the "other TCDF" and "hexa-CDF" had reported field blank values very close to the detection limit. Overall, the field clean-up procedures were found to be adequate for this test site. Emissions data reported in Section 5.4 are not blank-corrected.

8.3.2 Precursor Analyses

Table 8-7 presents analytical recovery efficiencies for seven isotopically labeled compounds used as surrogates for the target precursor analytes in the Site BLB-B feed samples. The surrogate recovery values in Table 8-7 vary considerably by specific surrogate species but are fairly uniform between runs for the same species. Several of the recoveries are below the 50 percent objective stated in the Tier 4 QA Project Plan and are below those generally considered achievable when analyzing for similar compounds in water or from MM5 train components. In spite of the relatively low surrogate recovery values for some of the feed samples, the resulting analytical sensitivity for the target analytes was considered acceptable for the purpose of this study.

8.3.3 Total Chloride Analysis

Total chloride analyses were performed by Radian/Austin on the HCl train samples. QA/QC activities include total chloride analysis of field recovery

Table 8-6. Field Blank Dioxin/Furan Data for Site BLB-B MM5 Samples

Isomer/Homologue	Amount Detected, Nanograms per Train					
	Field Blank Value		Minimum Test Run Value		Percentage[a]	
	Inlet	Outlet	Inlet	Outlet	Inlet	Outlet
Dioxins						
2378 TCDD	ND	ND	ND	ND	0	0
Other TCDD	ND	ND	ND	ND	0	0
Penta CDD	ND	ND	ND	ND	0	0
Hexa CDD	ND	ND	0.6	0.3	0	0
Hepta CDD	ND	ND	0.4	0.7	0	0
Octa CDD	0.3	ND	1.6	2.3	19	0
Furans						
2378 TCDF	ND	ND	ND	0.1	0	0
Other TCDF	ND	0.2	ND	0.2	0	100
Penta CDF	ND	ND	ND	ND	0	0
Hexa CDF	ND	0.2	ND	0.2	0	100
Hepta CDF	ND	ND	ND	0.1	0	0
Octa CDF	ND	ND	ND	0.1	0	0

---

[a] Percentage shown is the ratio of the field blank value to the minimum test run value, expressed as a percentage.

TABLE 8-7. PERCENT SURROGATE RECOVERIES FOR SITE BLB-B FEED SAMPLES

Surrogate Compound	Percent Surrogate Recovery			
	Black Liquor Feed			
	Run 01	Run 02	Run 03	Average
d_4-dichlorobenzene	91	73	70	78
bromobiphenyl	101	91	78	90
2',5,5' tetrabromobiphenyl	84	74	71	76
d_6-phenol	3	3	2	3
d_4-2-chlorophenol	9	9	7	8
$^{13}C_6$-pentachlorophenol	12	13	10	12

blank HCl train samples, total chloride analysis of an aliquot of the KOH solution used in the sample train impingers, and duplicate total chloride analyses of the impinger rinse from Run 02. Chlorides were not detected in either the field recovery blank train samples or the aliquot of KOH solution analyzed. Duplicate analyses of the impinger rinse of the HCl train from Run 02 differed by a factor of 2. Total chloride analysis was also performed in duplicate for the strong black liquor sample collected from Run 02. The duplicates differed by only 2 percent, which indicates excellent analytical precision.

APPENDIX A

FIELD SAMPLING DATA

APPENDIX A-1

MODIFIED METHOD 5 AND EPA METHODS 1-4 FIELD RESULTS

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE 05
PLANT SITE : NA , NA
SAMPLING LOCATION : REVISED DIAMETER
TEST # : 05-MM5-D-01
DATE : 02/26/85
TEST PERIOD : 1452-2043

PARAMETER	VALUE
Sampling time (min.)	160
Barometric Pressure (in.Hg)	30.22
Sampling nozzle diameter (in.)	.242
Meter Volume (cu.ft.)	82.693
Meter Pressure (in.H2O)	1.045
Meter Temperature (F)	93.53031
Stack dimension (sq.in.)	6133
Stack Static Pressure (in.H2O)	-4.5
Stack Moisture Collected (gm)	837.4
Absolute stack pressure(in Hg)	29.88912
Average stack temperature (F)	318.0909
Percent CO2	16.3242
Percent O2	3.8701
Percent N2	73.6014
Delps Subroutine result	21.36631
DGM Factor	1.0097
Pitot Constant	.84

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```
   RADIAN  SOURCE  TEST
   EPA  METHODS  2-5
   FINAL  RESULTS
PLANT                 : SITE 05
PLANT SITE            : NA , NA
SAMPLING LOCATION     : REVISED DIAMETER
TEST #                : 05-MM5-D-01
DATE                  : 02/26/85
TEST PERIOD           : 1452-2043

   PARAMETER                   RESULT
   ---------                   ------

   Vm(dscf)                     80.6472
   Vm(dscm)                     2.283929
   Vw gas(scf)                  39.48341
   Vw gas (scm)                 1.11817
   % moisture                   32.86707
   Md                           .6713293
   MWd                          29.02947
   MW                           25.40441
   Vs(fpm)                      3340.907
   Vs (mpm)                     1018.569
   Flow(acfm)                   142290.1
   Flow(acmm)                   4029.657
   Flow(dscfm)                  64753.83
   Flow(dscmm)                  1833.828
   % I                          103.8512
   % EA                         24.87104


                                          Program Revision:1/16/84
```

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT	: SITE 05
PLANT SITE	: NA , NA
SAMPLING LOCATION	: ESP INLET
TEST #	: 05-MM5-D-02
DATE	: 2/27/85
TEST PERIOD	: 1230-1925

PARAMETER	VALUE
Sampling time (min.)	200
Barometric Pressure (in.Hg)	30.2
Sampling nozzle diameter (in.)	.242
Meter Volume (cu.ft.)	104.71
Meter Pressure (in.H2O)	1.068
Meter Temperature (F)	94.275
Stack dimension (sq.in.)	6133
Stack Static Pressure (in.H2O)	-4.5
Stack Moisture Collected (gm)	1055.3
Absolute stack pressure(in Hg)	29.86912
Average stack temperature (F)	329.75
Percent CO2	15.1
Percent O2	4.7
Percent N2	74.7
Delps Subroutine result	22.14291
DGM Factor	1.0097
Pitot Constant	.84

```
    RADIAN SOURCE TEST
    EPA METHODS 2-5
    FINAL RESULTS
PLANT                : SITE 05
PLANT SITE           : NA , NA
SAMPLING LOCATION    : ESP INLET
TEST #               : 05-MM5-D-02
DATE                 : 2/27/85
TEST PERIOD          : 1230-1925

    PARAMETER                     RESULT
    ---------                     ------

    Vm(dscf)                       101.9207
    Vm(dscm)                       2.886393
    Vw gas(scf)                    49.7574
    Vw gas (scm)                   1.409129
    % moisture                     32.80461
    Md                             .671954
    MWd                            29.064
    MW                             25.4345
    Vs(fpm)                        3461.448
    Vs (mpm)                       1055.32
    Flow(acfm)                     147424
    Flow(acmm)                     4175.048
    Flow(dscfm)                    66116.96
    Flow(dscmm)                    1872.432
    % I                            102.8317
    % EA                           31.28995




                                          Program Revision:1/16/84
```

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE 05
PLANT SITE : NA , NA
SAMPLING LOCATION : REVISED DIAMETER
TEST # : 05-MM5-D-03
DATE : 02/28/85
TEST PERIOD : 1055-1615

PARAMETER	VALUE
Sampling time (min.)	200
Barometric Pressure (in.Hg)	30.2
Sampling nozzle diameter (in.)	.242
Meter Volume (cu.ft.)	104.71
Meter Pressure (in.H2O)	1.068
Meter Temperature (F)	95.6625
Stack dimension (sq.in.)	6133
Stack Static Pressure (in.H2O)	-4.5
Stack Moisture Collected (gm)	1037.9
Absolute stack pressure(in Hg)	29.86912
Average stack temperature (F)	335.35
Percent CO2	15.1
Percent O2	5.2
Percent N2	75
Delps Subroutine result	22.28008
DGM Factor	1.0097
Pitot Constant	.84

```
    RADIAN SOURCE TEST
    EPA METHODS 2-5
    FINAL RESULTS
PLANT                : SITE 05
PLANT SITE           : NA , NA
SAMPLING LOCATION    : REVISED DIAMETER
TEST #               : 05-MM5-D-03
DATE                 : 02/28/85
TEST PERIOD          : 1055-1615

    PARAMETER                    RESULT
    ---------                    ------

    Vm(dscf)                      101.6662
    Vm(dscm)                      2.879186
    Vw gas(scf)                   48.93699
    Vw gas (scm)                  1.385896
    % moisture                    32.49399
    Md                            .6750601
    MWd                           29.308
    MW                            25.63358
    Vs(fpm)                       3469.34
    Vs (mpm)                      1057.726
    Flow(acfm)                    147760.2
    Flow(acmm)                    4184.568
    Flow(dscfm)                   66105.29
    Flow(dscmm)                   1872.102
    % I                           102.5931
    % EA                          35.61644



                                              Program Revision:1/16/84
```

RADIAN SOURCE TEST
EPA METHOD 2 - 5
(RAW DATA)

PLANT : SITE05

PLANT SITE :

SAMPLING LOCATION : ESP OUTLET

TEST # : 05-MM5-E-01

DATE : 02/26/85

TEST PERIOD : 1415-2003

PARAMETER	VALUE
Sampling time (min.)	240
Barometric Pressure (in.Hg)	30.22
Sampling nozzle diameter (in.)	.25
Meter Volume (cu.ft.)	94.98908
Meter Pressure (in.H2O)	.6678125
Meter Temperature (F)	85.74167
Stack dimension (sq.in.)	16286.05
Stack Static Pressure (in.H2O)	-.6
Stack Moisture Collected (gm)	936.4724
Absolute stack pressure(in Hg)	30.17588
Average stack temperature (F)	317.1667
Percent CO2	14.1
Percent O2	5.9
Percent N2	74.5
Delps Subroutine result	16.16233
DGM Factor	1.0092
Pitot Constant	.84

```
      R A D I A N   S O U R C E   T E S T
      E P A   M E T H O D S   2 - 5
      F I N A L   R E S U L T S
   PLANT               : SITE05
   PLANT SITE          :
   SAMPLING LOCATION   : ESP OUTLET
   TEST #              : 05-MM5-E-01
   DATE                : 02/26/85
   TEST PERIOD         : 1415-2003

      PARAMETER                 RESULT
      ---------                 ------

      Vm(dscf)                   93.82869
      Vm(dscm)                   2.657229
      Vw gas(scf)                44.15468
      Vw gas (scm)               1.25046
      % moisture                 32
      Md                         .68
      MWd                        28.952
      MW                         25.44736
      Vs(fpm)                    2513.034
      Vs (mpm)                   766.169
      Flow(acfm)                 284218.1
      Flow(acmm)                 8049.055
      Flow(dscfm)                132427.7
      Flow(dscmm)                3750.351
      % I                        98.00472
      % EA                       42.853





                                                  Program Revision:1/16/84
```

RADIAN SOURCE TEST
EPA METHOD 2 - 5
(RAW DATA)

PLANT : SITE 05
PLANT SITE :
SAMPLING LOCATION : ESP OUTLET
TEST # : 05-MM5-E-02
DATE : 02/27/85
TEST PERIOD : 1300-1742

PARAMETER	VALUE
Sampling time (min.)	240
Barometric Pressure (in.Hg)	30.2
Sampling nozzle diameter (in.)	.308
Meter Volume (cu.ft.)	153.5271
Meter Pressure (in.H2O)	1.640208
Meter Temperature (F)	92.375
Stack dimension (sq.in.)	16286.05
Stack Static Pressure (in.H2O)	-.6
Stack Moisture Collected (gm)	1550.7
Absolute stack pressure(in Hg)	30.15589
Average stack temperature (F)	308.3542
Percent CO2	14.6
Percent O2	5.4
Percent N2	75.4
Delps Subroutine result	15.96329
DGM Factor	1.0092
Pitot Constant	.84

```
     R A D I A N   S O U R C E   T E S T
     E P A   M E T H O D S   2 - 5
     F I N A L   R E S U L T S
PLANT                  : SITE 05
PLANT SITE             :
SAMPLING LOCATION      : ESP OUTLET
TEST #                 : 05-MM5-E-02
DATE                   : 02/27/85
TEST PERIOD            : 1300-1742

     PARAMETER                      RESULT
     ---------                      ------

     Vm(dscf)                        150.0854
     Vm(dscm)                        4.250418
     Vw gas(scf)                     73.1155
     Vw gas (scm)                    2.070631
     % moisture                      32.75771
     Md                              .672423
     MWd                             29.264
     MW                              25.57417
     Vs(fpm)                         2476.746
     Vs (mpm)                        755.1054
     Flow(acfm)                      280113.9
     Flow(acmm)                      7932.825
     Flow(dscfm)                     130454.8
     Flow(dscmm)                     3694.48
     % I                             104.8448
     % EA                            37.227



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```

RADIAN SOURCE TEST
EPA METHOD 2 - 5
(RAW DATA)

PLANT	: SITE 05
PLANT SITE	:
SAMPLING LOCATION	: ESP OUTLET
TEST #	: 05-MM5-E-03
DATE	: 02/28/85
TEST PERIOD	: 1059-1553

PARAMETER	VALUE
Sampling time (min.)	240
Barometric Pressure (in.Hg)	30.22
Sampling nozzle diameter (in.)	.308
Meter Volume (cu.ft.)	158.035
Meter Pressure (in.H20)	1.7675
Meter Temperature (F)	87.42709
Stack dimension (sq.in.)	16286.05
Stack Static Pressure (in.H20)	-.6
Stack Moisture Collected (gm)	1486.5
Absolute stack pressure(in Hg)	30.17588
Average stack temperature (F)	318.5625
Percent CO2	15.3
Percent O2	5.3
Percent N2	75.7
Delps Subroutine result	16.7148
DGM Factor	1.0092
Pitot Constant	.84

```
      R A D I A N   S O U R C E   T E S T
      E P A   M E T H O D S   2 - 5
      F I N A L   R E S U L T S
   PLANT                 : SITE 05
   PLANT SITE            :
   SAMPLING LOCATION     : ESP OUTLET
   TEST #                : 05-MM5-E-03
   DATE                  : 02/28/85
   TEST PERIOD           : 1059-1553

     PARAMETER                  RESULT
     ---------                  ------

     Vm(dscf)                    156.0396
     Vm(dscm)                    4.41904
     Vw gas(scf)                 70.08848
     Vw gas (scm)                1.984906
     % moisture                  30.99504
     Md                          .6900496
     MWd                         29.624
     MW                          26.02114
     Vs(fpm)                     2570.123
     Vs (mpm)                    783.5742
     Flow(acfm)                  290674.7
     Flow(acmm)                  8231.908
     Flow(dscfm)                 137191.2
     Flow(dscmm)                 3885.255
     % I                         103.6518
     % EA                        36.09175




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```

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE 05
PLANT SITE :
SAMPLING LOCATION : ESP INLET-SOUTH DUCT
TEST # : PRELIMINARY VELOCITY
DATE : 02/25/85
TEST PERIOD : PM

PARAMETER	VALUE
Sampling time (min.)	160
Barometric Pressure (in.Hg)	30.22
Sampling nozzle diameter (in.)	.242
Meter Volume (cu.ft.)	82.693
Meter Pressure (in.H2O)	1.045
Meter Temperature (F)	93.53031
Stack dimension (sq.in.)	6291.25
Stack Static Pressure (in.H2O)	-4.5
Stack Moisture Collected (gm)	837.4
Absolute stack pressure(in Hg)	29.88912
Average stack temperature (F)	326.4211
Percent CO2	16.3242
Percent O2	3.8701
Percent N2	73.6014
Delps Subroutine result	22.04748
DGM Factor	1.0097
Pitot Constant	.84

```
       R A D I A N   S O U R C E   T E S T
       E P A   M E T H O D S   2 - 5
       F I N A L   R E S U L T S
    PLANT                : SITE 05
    PLANT SITE           :
    SAMPLING LOCATION    : ESP INLET-SOUTH DUCT
    TEST #               : PRELIMINARY VELOCITY
    DATE                 : 02/25/85
    TEST PERIOD          : PM

       PARAMETER                RESULT
       ---------                ------

       Vm(dscf)                  80.6472
       Vm(dscm)                  2.283929
       Vw gas(scf)               39.48341
       Vw gas (scm)              1.11817
       % moisture                32.86707
       Md                        .6713293
       MWd                       29.02947
       MW                        25.40441
       Vs(fpm)                   3447.417
       Vs (mpm)                  1051.042
       Flow(acfm)                150615
       Flow(acmm)                4265.417
       Flow(dscfm)               67816.28
       Flow(dscmm)               1920.557
       % I                       101.7201
       % EA                      24.87104




                                           Program Revision:1/16/84
```

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE 05
PLANT SITE :
SAMPLING LOCATION : ESP INLET-NORTH DUCT
TEST # : PRELIMINARY VELOCITY
DATE : 02/25/85
TEST PERIOD : PM

PARAMETER	VALUE
Sampling time (min.)	160
Barometric Pressure (in.Hg)	30.22
Sampling nozzle diameter (in.)	.242
Meter Volume (cu.ft.)	82.693
Meter Pressure (in.H20)	1.045
Meter Temperature (F)	93.53031
Stack dimension (sq.in.)	6291.25
Stack Static Pressure (in.H20)	-4.1
Stack Moisture Collected (gm)	837.4
Absolute stack pressure(in Hg)	29.91853
Average stack temperature (F)	322.8182
Percent CO2	16.3242
Percent O2	3.8701
Percent N2	73.6014
Delps Subroutine result	21.71486
DGM Factor	1.0097
Pitot Constant	.84

```
         R A D I A N   S O U R C E   T E S T
         E P A   M E T H O D S   2 - 5
         F I N A L   R E S U L T S
PLANT                : SITE 05
PLANT SITE           :
SAMPLING LOCATION    : ESP INLET-NORTH DUCT
TEST #               : PRELIMINARY VELOCITY
DATE                 : 02/25/85
TEST PERIOD          : PM

    PARAMETER                  RESULT
    ---------                  ------

    Vm(dscf)                    80.6472
    Vm(dscm)                    2.283929
    Vw gas(scf)                 39.48341
    Vw gas (scm)                1.11817
    % moisture                  32.86707
    Md                          .6713293
    MWd                         29.02947
    MW                          25.40441
    Vs(fpm)                     3393.738
    Vs (mpm)                    1034.676
    Flow(acfm)                  148269.8
    Flow(acmm)                  4199.001
    Flow(dscfm)                 67133.6
    Flow(dscmm)                 1901.223
    % I                         102.7546
    % EA                        24.87104




                                      Program Revision:1/16/84
```

```
      R A D I A N   S O U R C E   T E S T
      E P A   M E T H O D   2 - 5
      ( R A W   D A T A )
    PLANT                 : SITE 05
    PLANT SITE            :
    SAMPLING LOCATION     : ESP INLET-NORTH DUCT
    TEST #                : VELOCITY-1
    DATE                  : 02/26/85
    TEST PERIOD           : PM

  PARAMETER                                VALUE
  ---------                                -----

  Sampling time (min.)                      160
  Barometric Pressure (in.Hg)               30.22
  Sampling nozzle diameter (in.)            .242
  Meter Volume (cu.ft.)                     82.693
  Meter Pressure (in.H2O)                   1.045
  Meter Temperature (F)                     93.53031
  Stack dimension (sq.in.)                  6291.25
  Stack Static Pressure (in.H2O)           -3.8
  Stack Moisture Collected (gm)             837.4
  Absolute stack pressure(in Hg)            29.94059
  Average stack temperature (F)             320.5833
  Percent CO2                               16.3242
  Percent O2                                3.8701
  Percent N2                                73.6014
  Delps Subroutine result                   21.03932
  DGM Factor                                1.0097
  Pitot Constant                            .84
  R A D I A N   S O U R C E   T E S T
  E P A   M E T H O D S   2 - 5
  F I N A L   R E S U L T S
PLANT               : SITE 05
PLANT SITE          :
SAMPLING LOCATION   : ESP INLET-NORTH DUCT
TEST #              : VELOCITY-1
DATE                : 02/26/85
TEST PERIOD         : PM

  PARAMETER                 RESULT
  ---------                 ------

  Vm(dscf)                  80.6472
  Vm(dscm)                  2.283929
  Vw gas(scf)               39.48341
  Vw gas (scm)              1.11817
  % moisture                32.86707
  Md                        .6713293
  MWd                       29.02947
  MW                        25.40441
  Vs(fpm)                   3286.949
  Vs (mpm)                  1002.119
  Flow(acfm)                143604.3
  Flow(acmm)                4066.873
  Flow(dscfm)               65255.38
  Flow(dscmm)               1848.032
  % I                       105.7121
  % EA                      24.87104


                          Program Revision:1/16/84
```

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE 05
PLANT SITE :
SAMPLING LOCATION : ESP INLET-NORTH DUCT
TEST # : VELOCITY-2
DATE : 02/27/85
TEST PERIOD : PM

PARAMETER	VALUE
Sampling time (min.)	160
Barometric Pressure (in.Hg)	30.22
Sampling nozzle diameter (in.)	.242
Meter Volume (cu.ft.)	82.693
Meter Pressure (in.H2O)	1.045
Meter Temperature (F)	93.53031
Stack dimension (sq.in.)	6291.25
Stack Static Pressure (in.H2O)	-4.5
Stack Moisture Collected (gm)	837.4
Absolute stack pressure(in Hg)	29.88912
Average stack temperature (F)	334.087
Percent CO2	16.3242
Percent O2	3.8701
Percent N2	73.6014
Delps Subroutine result	22.66928
DGM Factor	1.0097
Pitot Constant	.84

```
     R A D I A N   S O U R C E   T E S T
     E P A   M E T H O D S   2 - 5
     F I N A L   R E S U L T S
PLANT               : SITE 05
PLANT SITE          :
SAMPLING LOCATION   : ESP INLET-NORTH DUCT
TEST #              : VELOCITY-2
DATE                : 02/27/85
TEST PERIOD         : PM

     PARAMETER                 RESULT
     ---------                 ------

     Vm(dscf)                   80.6472
     Vm(dscm)                   2.283929
     Vw gas(scf)                39.48341
     Vw gas (scm)               1.11817
     % moisture                 32.86707
     Md                         .6713293
     MWd                        29.02947
     MW                         25.40441
     Vs(fpm)                    3544.643
     Vs (mpm)                   1080.684
     Flow(acfm)                 154862.8
     Flow(acmm)                 4385.713
     Flow(dscfm)                69055.76
     Flow(dscmm)                1955.659
     % I                        99.89439
     % EA                       24.87104




                                           Program Revision:1/16/84
```

```
      RADIAN SOURCE TEST
      EPA METHODS 2-5
      FINAL RESULTS
PLANT                  : SITE 05
PLANT SITE             : CONFIDENTIAL , XX
SAMPLING LOCATION      : ESP INLET
TEST #                 : 05VELN3
DATE                   : 02/28/85 NORTH DUCT VELOCITY ONLY
TEST PERIOD            : 1055-1615

   PARAMETER                  RESULT
   ---------                  ------

   Vm(dscf)                    101.6662
   Vm(dscm)                    2.879186
   Vw gas(scf)                 48.93699
   Vw gas (scm)                1.385896
   % moisture                  32.49399
   Md                          .6750601
   MWd                         29.308
   MW                          25.63358
   Vs(fpm)                     3451.301
   Vs (mpm)                    1052.226
   Flow(acfm)                  150784.7
   Flow(acmm)                  4270.222
   Flow(dscfm)                 69642.28
   Flow(dscmm)                 1972.269
   % I                         99.85536
   % EA                        35.61644




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```

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```
   RADIAN SOURCE TEST
   EPA METHOD 2-5
   (RAW DATA)
PLANT                   : SITE 05
PLANT SITE              : CONFIDENTIAL . XX
SAMPLING LOCATION       : ESP INLET
TEST #                  : 05VELN3
DATE                    : 02/28/85 NORTH DUCT VELOCITY ONLY
TEST PERIOD             : 1055-1615

PARAMETER                                    VALUE
----------                                   -----

Sampling time (min.)                          200
Barometric Pressure (in.Hg)                   30.2
Sampling nozzle diameter (in.)                .242
Meter Volume (cu.ft.)                         104.71
Meter Pressure (in.H2O)                       1.068
Meter Temperature (F)                         95.6625
Stack dimension (sq.in.)                      6291.25
Stack Static Pressure (in.H2O)               -4.5
Stack Moisture Collected (gm)                 1037.9
Absolute stack pressure(in Hg)                29.86912
Average stack temperature (F)                 310.4091
Percent CO2                                   15.1
Percent O2                                    5.2
Percent N2                                    75
Delps Subroutine result                       22.16424
DGM Factor                                    1.0097
Pitot Constant                                .84
```

APPENDIX A-2

CONTINUOUS EMISSION MONITORING RESULTS

A27

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```
CEMS DATA - SITE 05 - TEST 1

**      FACTOR        **           NORMALIZED / CORRECTED DATA - WITH ACTUAL O2
**     FOR 3% O2      **
**   NORMALIZATION    **
**        OF          **
**   OTHER PROCESS    **        TIME       O2       CO       CO2      SO2      NOX
**       GASES        **                  (%V)    (PPMV)     (%V)   (PPMV)   (PPMV)
**                    **
**    ==========      **       =======  =======  =======  =======  =======  =======

**      4.9247        **          1350     17.3   7984.2     20.3    574.8     84.7
**      4.1679        **          1355     16.6   8165.7     17.6    636.5     66.4
**      4.4559        **          1400     16.9   9609.5     18.4    773.7     65.6
**      4.2135        **          1405     16.7  11103.7     18.0    837.0     62.6
**      4.1990        **          1410     16.6  10392.3     17.8    838.6     62.9
**      4.2470        **          1415     16.7  11137.4     17.8    971.6     63.4
**      4.1913        **          1420     16.6  10481.7     17.9    862.2     64.6
**      2.9025        **          1425     14.7  11990.8     18.2   1109.7     50.5
**      2.1066        **          1430     12.4  10150.2     16.0    884.8     41.5
**      1.9387        **          1435     11.7  12236.4     16.5   1255.3     35.6
**      2.0105        **          1440     12.0  11690.3     15.6   1062.6     36.9
**      2.0477        **          1445     12.2  13042.9     17.5   1328.9     36.7
**      1.9465        **          1450     11.7  12310.7     16.1   1325.1     32.3
**      2.3404        **          1455     13.3  12314.9     15.0   1270.8     28.1
**      1.9620        **          1505     11.8  12533.7     16.0   1548.3     26.8
**      2.2367        **          1510     12.9  12071.7     15.1   1541.7     38.8
**      1.9542        **          1515     11.7  12499.3     16.4   1558.6     31.3
**      2.0313        **          1520     12.1   9672.9     16.7    876.7     38.5
**      2.0729        **          1530     12.3  10274.7     17.0    942.7     41.8
**      2.0909        **          1535     12.3  11857.6     15.7   1136.3     32.8
**      2.2073        **          1540     12.8  12523.5     17.8   1295.3     38.8
**      2.0787        **          1545     12.3  11675.7     16.8   1185.0     36.3
**      2.2942        **          1550     13.1  10461.3     14.9   1020.4     30.6
**      2.1434        **          1555     12.5  12718.7     16.9   1321.8     31.4
**      2.2260        **          1600     12.9  12569.5     16.9   1336.9     30.5
**      2.4041        **          1605     13.5  10647.6     15.1   1045.2     29.3
**      2.1238        **          1610     12.5  11316.8     16.8   1094.0     33.7
**      2.1669        **          1615     12.6   9451.3     16.0    987.4     35.1
**      2.3614        **          1620     13.3   7144.6     16.1    821.0     43.7
**      2.1961        **          1625     12.7   5342.7     16.9    627.0     50.1
**      2.1919        **          1630     12.7   6974.0     15.9    750.8     44.0
**      2.3282        **          1635     13.2   8051.2     18.3    833.2     53.0
**      2.1352        **          1640     12.5   7558.6     16.9    770.1     46.3
**      2.2460        **          1645     12.9   7637.7     14.8    665.2     38.0
**      2.1522        **          1650     12.6   7691.8     17.0    699.7     46.7
**      2.1847        **          1655     12.7   6237.3     16.9    602.4     50.2
**      2.3219        **          1700     13.2   7008.4     15.3    636.4     44.4
**      2.2008        **          1705     12.8   5983.4     16.9    580.5     50.7
**      2.2608        **          1710     13.0   5392.9     16.9    571.4     51.5
**      2.5060        **          1715     13.8   6591.3     16.8    566.7     52.8
**      2.3409        **          1720     13.3   7274.2     17.1    654.7     53.2
**      2.3453        **          1725     13.3   6962.1     16.3    577.5     58.5
**      2.5768        **          1730     14.0   8946.0     19.0    675.3     59.6
**      2.3871        **          1735     13.4   7725.6     17.4    587.4     54.1
**      2.6014        **          1740     14.0   8828.1     15.4    631.8     43.0
**      2.3860        **          1745     13.4  10404.0     16.3    814.6     42.1
**      2.4404        **          1750     13.6  11954.2     18.8    915.0     45.6
**      2.2760        **          1755     13.0   8036.7     17.4    553.2     51.5
**      2.4169        **          1800     13.5  10373.2     15.4    757.1     35.0
**      2.1742        **          1805     12.7  10658.1     17.4    742.7     46.5
**      2.1915        **          1810     12.7  12484.5     17.3    973.4     37.0
**      2.3887        **          1815     13.4  10729.5     15.4    724.5     36.5
**      2.1486        **          1820     12.6  12000.0     17.2    907.2     37.1
**      2.1745        **          1825     12.7  13999.7     16.9   1209.2     27.8
**      2.4720        **          1830     13.7  13450.8     19.6   1109.3     35.3
**      2.2016        **          1835     12.8  10673.2     17.3    946.1     34.9
**      2.2185        **          1840     12.8   9528.3     16.8    723.9     43.7
**      2.3994        **          1845     13.4  10587.1     19.1    824.0     48.6
**      2.2429        **          1850     12.9  10728.1     17.4    888.4     40.0
**      2.5830        **          1855     14.0   9065.7     15.6    735.0     38.2
**      2.2329        **          1900     12.9   8915.2     17.4    729.0     46.2
**      2.2767        **          1905     13.0  13175.0     17.5   1164.9     28.9
**      2.4977        **          1910     13.7  13333.5     15.5   1290.2     16.0
**      2.2044        **          1915     12.8  14537.2     17.4   1528.7     11.7
**      2.1906        **          1920     12.7  14063.8     16.6   1481.5      9.5
**      2.1830        **          1925     12.7  14415.0     18.5   1414.0     18.4
**      2.0378        **          1930     12.1  13464.8     17.4   1212.9     23.2
**      1.9445        **          1935     11.7  12037.3     15.8    961.2     23.0
**      1.9526        **          1940     11.7  12902.3     17.9    938.9     32.2
**      1.9197        **          1945     11.6  12582.5     17.1    887.6     33.4
**      2.0345        **          1950     12.1  13065.5     18.6    966.4     36.7
**      1.8119        **          1955     11.0  12011.2     17.0   1003.1     32.5
**      1.8089        **          2000     11.0  11999.2     17.0   1033.4     33.2
**      2.1516        **          2005     12.6  14108.7     21.6   1262.0    119.3
**      1.8870        **          2010     11.4  12533.2     16.9   1085.0     30.3
**      2.0326        **          2015     12.1  12154.7     15.0    887.9     30.4
**      1.9023        **          2020     11.5  12523.8     17.5    658.2     41.9
=====================================================================================

NO. PTS.        77                 NO. PTS.     77       77       77       77       77
MEAN        2.4001                 MEAN       13.1  10607.8     17.0    948.6     41.6
STD. DEV.      0.6                 STD. DEV.   1.4   2357.8      1.2    272.8     15.7
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CEMS DATA - SITE 05 - TEST 1

.... THIS DATA HAS NOT BEEN REDUCED TO 3% O2 ....

TIME	O2 (%V)	CO (PPMV)	CO2 (%V)	SO2 (PPMV)	NOX (PPMV)	THC (PPMV)
1350	17.3	1621.3	4.1	81.7	17.2	44.4
1355	16.6	1939.2	4.2	107.9	15.9	73.2
1400	16.9	2156.6	4.1	122.2	14.7	29.7
1405	16.7	2633.3	4.3	140.1	14.8	32.8
1410	16.6	2474.9	4.2	141.0	15.0	37.7
1415	16.7	2622.4	4.2	161.4	[illegible]	34.7
1420	16.6	2500.0	4.3	145.2	15.4	42.1
1425	14.7	4131.2	6.3	272.1	17.4	34.2
1430	12.4	4010.3	7.6	305.6	19.7	31.9
1435	11.7	6311.5	8.5	472.0	18.3	31.6
1440	12.0	5014.5	7.8	386.3	18.4	57.1
1445	12.2	6769.4	8.6	449.3	17.9	37.0
1450	11.7	6224.6	8.3	497.2	16.6	46.6
1455	12.2	5261.9	6.4	394.7	12.0	52.0
1500						72.5
1505	11.8	4788.3	8.2	376.3	13.6	100.5
1510	12.9	5597.0	6.7	502.2	17.3	94.6
1515	11.7	6396.3	8.4	381.5	16.0	
1520	12.1	4761.9	8.2	313.5	19.0	
1525						
1530	12.3	4956.0	8.2	329.5	20.2	131.1
1535	12.3	5671.0	7.5	396.2	15.3	79.7
1540	12.0	5673.7	8.1	422.4	17.6	33.0
1545	12.3	5616.0	8.1	413.5	17.4	37.0
1550	13.1	4559.9	6.5	323.9	13.3	71.6
1555	12.5	5933.9	7.9	446.3	14.6	98.3
1600	12.9	5646.6	7.6	433.9	13.7	95.1
1605	13.5	4428.9	6.3	315.5	12.2	
1610	12.5	5328.6	7.9	373.2	15.9	
1615	12.6	4761.7	7.8	329.0	16.2	
1620	13.3	3023.6	6.0	231.4	18.5	
1625	12.7	2432.0	7.7	206.4	22.0	
1630	12.7	3101.7	7.2	240.0	20.1	
1635	13.2	3458.1	7.9	236.4	22.0	
1640	12.5	3340.0	7.9	261.1	21.7	
1645	12.9	3400.6	6.6	216.0	16.9	
1650	12.6	3373.9	7.9	233.2	21.7	
1655	12.7	2055.0	7.7	199.4	23.0	
1700	13.2	3010.4	6.6	199.1	19.1	
1705	12.0	2710.0	7.7	198.6	23.1	
1710	13.0	2303.5	7.5	182.5	22.0	
1715	13.0	2630.2	6.7	162.6	21.1	
1720	13.3	3107.5	7.3	201.5	22.7	
1725	13.3	2960.6	6.9	170.0	21.5	
1730	14.0	3471.0	7.4	186.6	23.1	
1735	13.4	3226.3	7.3	176.9	22.7	
1740	14.0	3393.6	5.9	175.3	16.5	28.1
1745	13.4	4360.4	6.8	246.6	17.7	16.6
1750	13.6	4898.5	7.7	267.7	18.7	19.4
1755	13.0	3531.0	7.6	175.0	22.6	22.7
1800	13.5	4292.0	6.4	226.9	14.5	21.9
1805	12.7	4982.0	8.0	246.5	21.4	17.5
1810	12.7	5696.0	7.9	338.5	16.9	28.5
1815	13.4	4471.0	6.5	219.9	15.3	29.2
1820	12.4	5622.4	8.0	305.1	17.3	
1825	12.7	6438.2	7.0	402.1	12.0	32.7
1830	13.7	5441.3	7.9	319.2	14.3	64.0
1835	12.0	4040.0	7.9	310.0	15.9	33.5
1840	13.0	4294.9	7.6	233.9	19.7	31.6
1845	13.4	4413.5	7.9	245.3	20.3	24.3
1850	12.9	4779.6	7.7	285.5	17.0	28.4
1855	14.0	3309.0	6.0	205.4	14.0	40.1
1900	12.9	3992.7	7.0	235.3	20.7	38.2
1905	13.0	5796.0	7.7	360.3	12.7	47.2
1910	13.7	[illegible]	6.2	373.6	6.4	35.3
1915	12.0	6594.7	7.9	500.2	[illegible]	55.1
1920	12.7	6428.1	7.6	463.2	4.3	40.2
1925	12.7	6683.2	8.5	464.0	9.4	
1930	12.1	6687.5	8.5	430.0	11.4	49.5
1935	11.7	6198.3	9.1	361.7	11.0	73.2
1940	11.7	6687.7	9.1	367.9	16.5	78.5
1945	11.6	6554.5	8.9	376.1	17.4	179.7
1950	12.1	6421.0	9.1	341.7	18.0	165.9
1955	11.0	6629.0	9.4	404.0	17.9	142.0
2000	11.0	6633.3	9.4	416.0	18.4	143.5
2005	12.6	6557.2	10.0	415.0	33.4	174.1
2010	11.4	6641.9	8.9	300.1	16.1	81.5
2015	12.1	5979.9	7.8	318.0	14.9	
2020	11.5	6383.6	9.2	331.2	22.0	113.5
2025						117.1
2030						96.7
2035						126.5
2040						137.5
2045						126.0
2050						133.3
2055						139.0
2100						48.9
2105						46.5
NO. PTS.	77	77	77	77	77	63
MEAN	13.1	4677.7	7.4	304.0	17.5	66.9
STD. DEV.	1.4	1474.6	1.3	114.5	5.9	43.7

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CEMS DATA - SITE 5 - TEST 2

	FACTOR FOR 3% O2 NORMALIZATION OF OTHER PROCESS GASES		NORMALIZED / CORRECTED DATA - WITH ACTUAL O2					
			TIME	O2 (%V)	CO (PPMV)	CO2 (%V)	SO2 (PPMV)	NOX (PPMV)
**	2.2379	**	1115	12.9	15134.3	19.2	1421.2	31.9
**	2.5249	**	1120	13.0	14404.4	18.5	1107.4	44.5
**	2.2380	**	1125	12.9	15033.6	19.9	1105.2	37.7
**	2.1700	**	1130	12.7	14675.0	19.8	1391.0	31.5
**	2.1713	**	1135	12.7	14603.7	20.2	1281.3	34.0
**	2.1242	**	1140	12.5	14365.1	19.6	1383.9	38.0
**	2.1643	**	1145	12.6	14636.2	19.9	1443.6	38.9
**	2.1300	**	1150	12.5	14483.7	19.5	1276.4	33.3
**	2.1171	**	1155	12.4	14317.1	19.7	1390.3	29.3
**	2.1109	**	1200	12.5	14204.3	19.8	1265.1	38.9
**	2.1004	**	1205	12.4	14122.3	20.2	1029.7	39.7
**	2.1121	**	1210	12.4	13963.6	19.8	1052.8	37.1
**	2.1063	**	1215	12.7	13839.5	17.7	1059.3	31.2
**	2.1986	**	1220	12.7	12936.0	20.2	984.5	40.6
**	2.1063	**	1225	12.7	14480.0	19.6	784.5	36.2
**	2.1973	**	1230	12.8	14840.4	20.0	1279.0	32.5
**	2.1717	**	1235	12.7	13715.2	19.4	816.7	34.0
**	2.1683	**	1240	12.6	13738.5	19.7	948.5	41.1
**	2.1680	**	1245	12.6	13982.9	19.5	972.4	39.5
**	2.0099	**	1250	12.3	12974.0	19.5	987.0	41.9
**	2.1996	**	1255	12.0	11918.9	17.7	873.2	41.2
**	2.1233	**	1300	12.5	10174.9	20.2	662.0	63.9
**	2.0938	**	1305	12.3	10043.1	19.5	669.0	54.6
**	2.1213	**	1310	12.5	8914.7	17.3	563.4	55.1
**	2.1671	**	1315	12.6	7685.4	19.9	513.9	74.7
**	2.1279	**	1320	12.5	7747.9	19.4	456.4	73.4
**	2.0780	**	1325	12.3	7696.3	19.7	477.0	76.0
**	2.0282	**	1330	12.0	7255.0	19.2	414.1	74.9
**	2.0241	**	1335	12.1	8998.9	19.4	527.6	68.4
**	2.0017	**	1340	12.0	8890.0	19.6	588.2	68.6
**	2.0000	**	1345	12.0	9966.4	19.1	663.7	62.1
**	2.1213	**	1350	12.5	11126.1	17.7	712.4	51.9
**	2.0908	**	1355	12.4	13901.0	19.9	870.6	49.6
**	2.0362	**	1400	12.1	13755.9	19.3	1127.0	42.4
**	2.1426	**	1405	12.5	12172.4	16.9	889.7	44.6
**	2.0525	**	1410	12.2	13438.3	19.5	1055.9	47.0
**	2.0421	**	1415	12.1	11129.7	19.1	781.7	58.5
**	2.0083	**	1420	12.3	13866.7	19.3	1177.7	44.5
**	2.0446	**	1425	12.1	13772.3	18.9	1255.1	41.6
**	2.0990	**	1430	12.4	14208.1	19.2	1555.9	34.0
**	2.1223	**	1435	12.5	13989.1	19.4	1074.3	44.2
**	2.1207	**	1440	12.5	13348.6	19.1	839.0	46.2
**	2.2347	**	1445	12.9	12761.6	17.3	868.1	42.1
**	2.1000	**	1450	12.4	13433.9	19.7	892.3	47.6
**	2.1110	**	1455	12.4	13376.0	19.0	947.4	43.4
**	2.2664	**	1500	13.0	10896.0	17.0	649.4	58.3
**	2.1300	**	1505	12.6	13972.7	19.0	980.3	45.2
**	2.1070	**	1510	12.4	14179.6	19.1	1180.4	37.2
**	2.1266	**	1515	12.5	14381.7	19.3	1362.1	33.7
**	2.1127	**	1520	12.4	14138.1	19.1	1324.3	33.0
**	2.1034	**	1525	12.4	14211.4	19.3	1169.7	33.0
**	2.1173	**	1530	12.4	13672.3	19.4	980.3	41.2
**	2.1466	**	1535	12.6	13589.0	19.2	923.1	36.7
**	2.1086	**	1540	12.7	13980.2	19.2	1134.9	34.4
**	2.1070	**	1545	12.7	12833.0	19.7	1070.5	43.0
**	2.1684	**	1550	12.6	13246.0	19.3	1034.9	36.0
**	2.1960	**	1555	12.7	14550.1	19.3	1243.2	31.7
**	2.1634	**	1600	12.6	14840.9	19.7	1219.9	32.9
**	2.1054	**	1605	12.7	14424.0	19.4	1328.0	31.2
**	2.1540	**	1610	12.6	13711.6	18.5	1149.0	31.4
**	2.1900	**	1615	12.8	14812.2	19.3	1140.3	34.6
**	2.2138	**	1620	12.8	13331.2	19.5	1016.5	37.1
**	2.1498	**	1625	12.6	13859.6	17.9	962.7	31.7
**	2.1767	**	1630	12.7	13537.6	19.5	993.6	34.9
**	2.2478	**	1635	12.9	12438.2	19.3	896.2	41.3
**	2.3200	**	1640	13.2	14989.5	20.0	1224.3	33.7
**	2.3061	**	1645	13.1	15319.0	19.5	1336.6	38.1
**	2.2787	**	1650	13.0	13861.3	19.7	1163.0	31.9
**	2.3214	**	1655	13.2	14774.2	19.7	1114.0	33.1
**	2.3498	**	1700	13.3	14469.1	19.6	1040.0	32.9
**	2.4174	**	1705	13.5	12623.4	17.3	942.0	33.3
**	2.3388	**	1710	13.2	12175.7	19.6	784.0	42.1
**	2.4138	**	1715	13.5	10340.4	19.8	596.7	57.0
**	2.3596	**	1720	13.3	8537.5	17.3	455.0	40.7
**	2.3874	**	1725	13.4	14187.0	19.4	1086.2	33.2
**	2.4434	**	1730	13.6	14875.1	20.3	1192.6	32.5
**	2.3348	**	1735	13.2	11795.6	20.4	793.5	47.0
**	2.4208	**	1740	13.5	12482.4	19.7	891.6	40.9
**	2.3987	**	1745	13.4	13173.6	19.6	977.7	36.2
**	2.3696	**	1750	13.3	13335.7	20.0	1059.7	36.3
**	2.2542	**	1755	13.0	13080.1	19.5	867.6	38.0
**	2.3665	**	1800	13.3	9840.0	16.7	401.2	45.9
**	2.2397	**	1805	12.9	10893.0	19.2	646.1	53.1
**	2.3193	**	1810	13.2	13292.5	19.4	822.6	36.5
**	2.3331	**	1815	13.3	12484.3	16.2	858.4	29.5
**	2.2981	**	1820	13.1	13932.3	19.2	1012.9	39.0
**	2.2841	**	1825	13.1	11865.5	18.9	822.2	49.5
**	2.2636	**	1830	13.0	12010.3	19.0	812.9	48.7
**	2.3533	**	1835	13.3	12786.6	19.3	888.7	46.6
**	2.4073	**	1840	13.5	13376.0	18.6	917.5	41.9
**	2.4212	**	1845	13.3	14593.1	19.7	1130.0	39.4

NO. PTS.	91	NO. PTS.	91	91	91	91	91
MEAN	2.2812	MEAN	12.7	12926.0	19.2	976.0	42.3
STD. DEV.	0.1	STD. DEV.	0.4	1910.0	0.9	264.6	11.2

CEMS DATA - SITE 5 - TEST 2

''''''''''' THIS DATA HAS NOT BEEN REDUCED TO 3% O2 '''''''''''

TIME	O2 (%V)	CO (PPMV)	CO2 (%V)	SO2 (PPMV)	NOX (PPMV)	THC (PPMV)
1115	12.9	6762.7	8.6	453.0	14.3	145.2
1120	13.0	5736.7	7.3	313.1	17.6	74.4
1125	12.9	6718.3	8.9	377.2	16.9	33.1
1130	12.7	6762.7	9.1	457.4	14.5	97.0
1135	12.7	6762.7	9.3	420.1	15.7	111.3
1140	12.5	6762.7	9.2	465.6	14.5	43.0
1145	12.6	6762.7	9.2	475.0	14.3	102.0
1150	12.5	6762.3	9.1	420.4	[illegible]	89.9
1155	12.4	6762.7	9.3	576.6	13.9	20.5
1200	12.5	6741.4	9.4	426.3	14.6	39.9
1205	12.4	6690.3	9.6	340.0	18.0	92.9
1210	12.4	6611.2	9.4	356.0	17.6	96.5
1215	12.7	5963.6	8.1	340.9	14.3	60.9
1220	12.7	5914.7	9.2	294.0	22.2	40.0
1225	12.7	6586.4	9.0	270.0	16.5	33.2
1230	12.8	4757.6	9.1	414.0	14.0	
1235	12.7	6215.5	8.9	260.9	16.9	29.4
1240	12.6	6355.0	9.1	312.4	19.0	32.1
1245	12.6	6436.5	9.0	321.6	18.3	33.0
1250	12.3	6207.9	9.3	310.5	20.0	36.1
1255	12.8	5410.7	8.0	285.9	18.7	33.7
1300	12.5	4793.0	9.5	222.1	30.1	31.4
1305	12.3	5100.5	9.3	229.0	26.1	46.9
1310	12.5	4202.5	8.2	191.9	26.0	35.4
1315	12.6	3546.4	9.2	169.1	34.5	
1320	12.5	3641.1	9.1	153.4	34.5	43.9
1325	12.3	3702.9	9.5	164.4	36.6	41.2
1330	12.8	3391.6	9.5	147.1	37.1	46.0
1335	12.1	4441.9	9.6	186.7	33.0	26.6
1340	12.8	4441.6	9.8	210.5	34.3	24.1
1345	12.8	4963.3	9.5	237.2	30.9	20.6
1350	12.5	5245.0	8.4	242.2	24.5	19.3
1355	12.4	6624.6	9.5	296.1	23.6	24.5
1400	12.1	6755.7	9.5	396.7	20.0	
1405	12.5	5601.0	7.9	273.5	20.0	50.6
1410	12.2	6547.1	9.5	360.2	22.9	40.2
1415	12.1	5450.1	9.3	246.5	20.6	37.4
1420	12.3	6640.3	9.3	403.0	21.3	54.7
1425	12.1	6775.9	9.2	440.9	20.3	74.5
1430	12.4	6762.7	9.1	530.9	16.4	44.7
1435	12.5	6591.6	9.1	362.2	20.0	35.7
1440	12.5	6294.5	9.0	283.5	21.0	37.6
1445	12.9	5710.7	7.7	200.1	18.0	73.7
1450	12.4	6302.6	9.4	302.0	22.6	62.7
1455	12.4	6336.6	9.0	321.7	20.5	93.1
1500	13.0	4000.0	7.5	206.7	22.2	
1505	12.6	6497.4	9.2	327.0	21.0	70.0
1510	12.4	6727.3	9.1	376.0	17.7	77.9
1515	12.5	6762.7	9.1	450.4	15.4	111.0
1520	12.4	6600.2	9.0	449.1	16.6	72.0
1525	12.4	6756.3	9.2	390.0	17.0	50.5
1530	12.4	6457.5	9.2	386.9	19.5	24.0
1535	12.6	6338.5	8.9	307.0	17.1	23.2
1540	12.7	6413.6	8.8	372.3	15.0	67.6
1545	12.7	5869.0	9.0	351.9	19.7	
1550	12.6	6100.9	8.9	341.2	17.0	95.7
1555	12.7	6625.7	8.8	405.3	14.4	176.0
1600	12.6	6490.1	9.1	402.5	15.2	96.5
1605	12.7	6600.2	8.9	431.9	14.3	92.6
1610	12.6	6763.0	8.6	383.4	14.6	
1615	12.8	6372.0	8.8	370.6	15.0	103.4
1620	12.8	4850.9	8.8	327.0	16.0	60.1
1625	12.6	6075.7	8.3	322.6	14.7	35.1
1630	12.7	6219.3	9.0	326.1	16.0	72.2
1635	12.9	5529.0	8.6	284.0	18.4	41.3
1640	13.2	6425.2	8.9	374.1	14.5	20.7
1645	13.1	6642.9	8.4	413.4	13.1	91.4
1650	13.0	6609.5	8.6	370.3	14.0	54.3
1655	13.2	6364.4	8.5	341.7	14.3	86.4
1700	13.3	6157.5	8.4	317.0	14.0	42.0
1705	13.5	5222.0	7.2	280.3	13.0	41.4
1710	13.2	5205.9	8.4	239.1	18.0	32.7
1715	13.5	4205.3	8.2	175.9	23.6	43.0
1720	13.3	3610.1	7.4	130.7	20.7	
1725	13.4	5942.9	8.1	323.7	13.9	39.1
1730	13.6	6096.1	8.3	346.3	13.3	49.6
1735	13.2	5052.7	8.7	241.3	20.1	55.0
1740	13.5	5156.4	8.2	262.0	16.9	53.6
1745	13.4	5492.0	8.2	290.2	15.1	59.2
1750	13.3	5627.0	8.4	317.9	15.3	32.2
1755	13.0	5770.7	8.7	274.6	17.2	50.1
1800	13.3	4161.5	7.0	146.7	19.4	75.0
1805	12.9	4729.7	8.6	206.2	23.7	
1810	13.2	5731.3	8.4	253.0	15.7	65.2
1815	13.3	5305.6	6.9	263.7	12.6	40.1
1820	13.1	6007.1	8.4	315.5	17.4	53.3
1825	13.1	5194.9	8.3	257.5	21.7	67.0
1830	13.0	5305.7	8.4	256.0	21.5	42.0
1835	13.3	5399.6	8.2	260.4	19.0	71.7
1840	13.5	5629.9	7.7	272.4	17.4	51.5
1845	13.5	6027.3	8.1	334.3	16.3	51.4
1850						33.2
1855						43.0
1900						46.5
1905						69.4
1910						106.0
1915						60.5
1920						60.9
1925						49.7
1930						109.3
1935						126.0
NO. PTS.	91	91	91	91	91	93
MEAN	12.7	5879.6	8.8	310.0	19.3	59.2
STD. DEV.	0.4	803.0	0.6	80.3	5.7	27.0

CEMS DATA - SITE 05 - TEST 3

FACTOR FOR 3% O_2 NORMALIZATION OF OTHER PROCESS GASES	NORMALIZED / CORRECTED DATA - WITH ACTUAL O_2					
	TIME	O_2 (%V)	CO (PPMV)	CO_2 (%V)	SO_2 (PPMV)	NOX (PPMV)
1.8302	1100	11.1	10385.5	15.3	491.2	31.3
1.8064	1105	11.0	11835.1	17.9	646.6	32.7
1.7695	1110	10.8	9441.5	17.3	537.6	41.9
1.8766	1115	11.4	7513.7	14.8	349.7	37.2
1.9603	1120	11.8	11352.8	16.7	695.6	34.2
1.8271	1125	11.1	11792.3	17.1	662.4	36.1
1.7729	1130	10.8	10970.6	16.9	521.3	38.6
1.8158	1135	11.0	9460.2	14.4	453.7	32.3
1.8495	1140	11.2	11735.0	17.8	583.1	37.1
1.8309	1145	11.1	10551.0	17.1	595.0	40.7
1.7616	1150	10.7	9042.6	16.9	540.3	42.8
1.7825	1155	10.9	9524.1	15.8	524.4	32.0
1.8407	1200	11.2	9495.2	18.3	561.2	45.1
1.7488	1205	10.7	10148.2	16.9	571.6	40.3
1.7594	1210	10.7	9232.7	15.3	517.5	37.9
1.8303	1215	11.1	11733.0	17.8	718.5	41.5
1.7404	1220	10.6	7485.7	16.8	525.6	55.3
1.9207	1225	11.6	5037.7	14.4	335.0	50.4
1.7511	1230	10.7	5063.4	16.7	329.5	54.6
2.0009	1235	12.0	5528.7	17.4	366.3	59.2
2.0048	1240	12.0	5588.6	17.1	392.7	58.0
1.7819	1245	10.9	2181.1	16.8	335.0	70.0
1.7849	1250	10.9	2028.2	16.1	293.5	66.5
1.7531	1255	10.7	2832.6	16.7	369.8	62.0
1.8191	1300	11.1	2371.1	14.1	307.0	53.7
1.7675	1305	10.8	2808.7	16.4	365.2	55.5
1.6925	1310	10.3	9282.6	16.6	644.4	47.3
1.6899	1315	10.3	7981.2	16.4	582.2	51.6
1.7998	1320	11.0	7698.2	14.6	477.7	43.8
1.6797	1325	10.2	10026.2	16.3	622.7	46.8
1.7065	1330	10.4	10693.0	16.6	613.4	45.4
1.7441	1335	10.6	10893.8	16.4	679.3	42.2
1.6942	1340	10.3	11087.6	16.3	772.3	38.7
1.6745	1345	10.2	10755.3	16.1	790.2	38.3
1.6959	1350	10.3	11010.9	16.4	603.0	40.5
1.7033	1355	10.4	11014.8	16.2	655.1	42.2
1.7763	1400	10.8	5750.5	7.3	401.1	21.9
1.8533	1405	11.2	11912.9	18.2	680.8	49.1
1.7749	1410	10.8	11513.3	17.6	844.5	49.2
2.5798	1415	14.0	3318.6	0.9	206.9	
1.7323	1425	10.6	11065.3	16.4	558.9	44.1
1.8242	1430	11.1	11181.0	16.3	608.4	47.7
1.7537	1435	10.7	11313.1	16.4	646.0	42.7
1.7589	1440	10.7	11329.6	16.2	720.0	40.4
1.7514	1445	10.7	11339.5	16.8	657.6	41.8
1.7623	1450	10.7	11407.5	16.4	741.2	39.4
1.7557	1455	10.7	11355.8	16.3	782.6	33.4
1.7441	1500	10.6	11283.4	16.8	753.2	35.8
1.7785	1505	10.8	11502.6	16.3	833.1	34.4
1.8753	1510	11.4	10964.7	15.2	671.4	32.3
1.7457	1515	10.6	10523.5	16.6	595.4	44.6
1.7658	1520	10.8	11342.2	16.6	684.8	32.7
1.8778	1525	11.4	11132.0	16.5	756.2	37.0
1.8245	1530	11.1	9906.8	16.8	521.4	45.0
1.7606	1535	10.7	11132.1	16.6	555.0	39.9
1.7884	1540	10.9	11521.7	17.1	572.0	40.2
1.7896	1545	10.9	11314.2	16.6	665.5	41.7
1.7875	1550	10.9	11168.5	16.6	648.2	44.8
1.7896	1555	10.9	10656.2	16.9	617.5	47.6
1.7812	1600	10.9	7464.2	16.5	508.7	57.0
1.9648	1605	11.8	6946.6	16.8	439.2	56.0
1.7902	1610	10.9	7620.1	16.6	409.5	55.1
1.7961	1615	10.9	9685.3	16.8	594.5	46.2
1.8666	1620	11.3	8310.1	16.7	476.3	49.8

NO. PTS.	64	NO. PTS.	64	64	64	64	63
MEAN	1.8051	MEAN	10.9	9210.4	16.1	565.3	44.0
STD. DEV.	0.1	STD. DEV.	0.5	2795.7	2.4	143.9	9.1

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CEMS DATA - SITE 5 - TEST 3

.......... THIS DATA HAS NOT BEEN REDUCED TO 3% O2 ...........

  TIME        O2        CO        CO2       SO2       NOX       THC
             (%V)     (PPMV)     (%V)     (PPMV)    (PPMV)    (PPMV)

-------   -------   -------   -------   -------   -------   -------

   1100      11.1    5674.6       8.3     197.7      17.1      64.5
   1105      11.0    6551.7       9.9     239.9      18.1      59.7
   1110      10.8    5335.7       9.8     221.5      23.7      77.2
   1115      11.4    4884.0       7.9     137.4      19.0      37.9
   1120      11.0    5791.4       8.5     250.3      17.5      45.0
   1125      11.1    6454.2       9.4     264.3      19.0      56.1
   1130      10.8    6100.0       9.5     215.0      21.0      61.0
   1135      11.0    5289.9       7.9     185.1      17.9      46.7
   1140      11.2    6345.1       9.6     228.0      20.1      43.3
   1145      11.1    5762.7       9.4     236.0      22.3      40.7
   1150      10.7    5133.3       9.6     224.2      24.3      36.7
   1155      10.9    5343.2       8.9     216.4      18.0      33.6
   1200      11.2    5150.4       9.9     228.7      24.5      50.7
   1205      10.7    5003.1       9.6     239.2      23.1      36.5
   1210      10.7    5247.6       8.7     217.3      21.5      54.4
   1215      11.1    6410.4       9.7     205.0      22.7      51.0
   1220      10.6    4381.1       9.7     221.1      31.0      54.1
   1225      11.6    2612.0       7.5     128.1      26.1      46.0
   1230      10.7    2891.6       9.5     137.0      31.2      11.3
   1235      12.0    2763.1       8.7     132.6      29.6       6.3
   1240      12.0    2787.6       8.5     142.1      20.9      19.6
   1245      10.9    1224.0       9.4     137.5      39.3      20.2
   1250      10.9    1176.3       9.0     120.7      37.3      43.7
   1255      10.7    1615.0       9.5     134.5      35.4       7.2
   1300      11.1    1303.4       7.7     125.2      29.5       9.5
   1305      10.8    1509.1       9.3     151.6      31.4       7.0
   1310      10.3    5484.6       9.0     279.7      27.9      13.2
   1315      10.3    4723.0       9.7     253.4      30.5      11.9
   1320      11.0    4277.3       8.1     196.5      24.3       9.9
   1325      10.2    5969.2       9.7     272.9      27.0      30.5
   1330      10.4    6265.9       9.7     262.9      26.6      24.1
   1335      10.6    6246.2       9.4     285.9      24.2      62.5
   1340      10.3    6497.3       9.6     335.3      22.9      31.2
   1345      10.2    6423.1       9.6     340.0      22.9      33.2
   1350      10.3    6492.6       9.7     261.3      23.9      40.6
   1355      10.4    6466.9       9.5     282.9      24.8      41.9
   1400      10.8    3237.3       4.1     175.0      12.3      46.6
   1405      11.2    6427.9       9.0     265.9      26.5       0.1
   1410      10.8    6486.0       9.9     346.4      27.7
   1415      14.0    1286.4       8.3      61.5                33.0
   1420                                                        42.4
   1425      10.6    6387.6       9.5     236.9      25.4      45.4
   1430      11.1    6129.3       8.9     244.2      26.2      31.4
   1435      10.7    6450.9       9.4     270.2      24.4     330.5
   1440      10.7    6441.2       9.2     300.7      25.0     231.3
   1445      10.7    6474.7       9.6     274.9      23.9      50.0
   1450      10.7    6473.0       9.3     300.5      22.3      49.0
   1455      10.7    6460.1       9.3     327.1      19.0      33.1
   1500      10.6    6469.5       9.6     316.2      20.5      42.0
   1505      10.8    6467.0       9.2     343.6      19.4      53.0
   1510      11.4    5847.0       8.1     263.4      17.2      34.7
   1515      10.6    6820.3       9.5     250.0      25.6      36.4
   1520      10.8    6423.2       9.4     284.1      18.5      30.3
   1525      11.4    5920.3       8.8     294.1      19.7      65.6
   1530      11.1    5429.9       9.2     200.6      24.7      47.4
   1535      10.7    6323.1       9.4     231.0      22.7      60.0
   1540      10.9    6442.5       9.5     333.5      22.5
   1545      10.9    6322.3       9.3     272.1      23.3      60.3
   1550      10.9    6240.3       9.3     265.5      25.1      59.4
   1555      10.9    5754.6       9.4     252.1      26.6      46.9
   1600      10.9    4190.5       9.3     209.2      32.0      54.6
   1605      11.0    3333.5       8.5     162.6      20.5      64.3
   1610      10.9    4256.7       9.3     167.4      30.0      57.5
   1615      10.9    5392.5       9.3     242.0      25.7      49.2
   1620      11.3    4452.0       8.9     186.2      26.7      61.7
   1625                                                        31.0
   1630                                                        19.0
   1635                                                        12.9
   1640                                                        25.3
   1645                                                        29.1
   1650                                                        17.7
          ==============================================================

NO. PTS.       64        64        64        64        63        69
   MEAN      10.9    5147.0       9.0     231.7      24.6      46.9
STD. DEV.     0.5    1620.7       1.4      62.7       5.0      46.0
```

APPENDIX A-3

HCl TRAIN RESULTS

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE 05
PLANT SITE :
SAMPLING LOCATION : ESP OUTLET
TEST # : 05-HCL-E-01
DATE : 02/26/85
TEST PERIOD : 1448-1648

PARAMETER	VALUE
Sampling time (min.)	120
Barometric Pressure (in.Hg)	30.22
Sampling nozzle diameter (in.)	.247
Meter Volume (cu.ft.)	47.60401
Meter Pressure (in.H20)	.4908333
Meter Temperature (F)	95.25
Stack dimension (sq.in.)	16286.05
Stack Static Pressure (in.H20)	-.6
Stack Moisture Collected (gm)	451.7
Absolute stack pressure(in Hg)	30.17588
Average stack temperature (F)	313.6667
Percent CO2	14.1003
Percent O2	5.8937
Percent N2	74.5374
Delps Subroutine result	14.21983
DGM Factor	.9924
Pitot Constant	.84

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     R A D I A N   S O U R C E   T E S T
     E P A   M E T H O D S   2 - 5
     F I N A L   R E S U L T S
   PLANT                  : SITE 05
   PLANT SITE             :
   SAMPLING LOCATION      : ESP OUTLET
   TEST #                 : 05-HCL-E-01
   DATE                   : 02/26/85
   TEST PERIOD            : 1448-1648

     PARAMETER                    RESULT
     ---------                    ------

     Vm(dscf)                      45.42835
     Vm(dscm)                      1.286531
     Vw gas(scf)                   21.29766
     Vw gas (scm)                  .6031496
     % moisture                    31.91808
     Md                            .6808193
     MWd                           28.96059
     MW                            25.46218
     Vs(fpm)                       2210.359
     Vs (mpm)                      673.8898
     Flow(acfm)                    249986.2
     Flow(acmm)                    7079.609
     Flow(dscfm)                   117145.7
     Flow(dscmm)                   3317.565
     % I                           109.9023
     % EA                          42.75701



                                                 Program Revision:1/16/84
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```
          R A D I A N   S O U R C E   T E S T
          E P A   M E T H O D   5
      P A R T I C U L A T E   L O A D I N G
        PLANT               : SITE 05
        PLANT SITE          :
        SAMPLING LOCATION   : ESP OUTLET
        TEST #              : 05-HCL-E-01
        DATE                : 02/26/85
        TEST PERIOD         : 1448-1648

  PARAMETER           FRONT-HALF          TRAIN TOTAL
  --------            ----------          -----

  Total Grams         0.0034700           0.0000000
  Grams/dscf          0.0000764           0.0000000
  Grams/acf           0.0000358           0.0000000
  Grains/dscf         0.0011786           0.0000000
  Grains/acf          0.0005523           0.0000000
  Grams/dscm          0.0026971           0.0000000
  Grams/acm           0.0012639           0.0000000
  Pounds/dscf         0.0000002           0.0000000
  Pounds/acf          0.0000001           0.0000000
  Pounds/Hr           1.1838280           0.0000000
  Kilograms/Hr        0.5369808           0.0000000

      * BACK-HALF IMPINGER ANALYSIS WAS NOT REQUIRED



                                                   Program Revision:1/16/84
```

RADIAN SOURCE TEST
EPA METHOD 2-5
(RAW DATA)

PLANT : SITE 05
PLANT SITE :
SAMPLING LOCATION : OUTLET - HCL
TEST # : 05-HCL-E-02
DATE : 02/27/85
TEST PERIOD : 1306-1506

PARAMETER	VALUE
Sampling time (min.)	120
Barometric Pressure (in.Hg)	30.2
Sampling nozzle diameter (in.)	.247
Meter Volume (cu.ft.)	53.034
Meter Pressure (in.H2O)	.6208333
Meter Temperature (F)	82.45835
Stack dimension (sq.in.)	16286.05
Stack Static Pressure (in.H2O)	-.6
Stack Moisture Collected (gm)	525.9
Absolute stack pressure(in Hg)	30.15589
Average stack temperature (F)	313.6667
Percent CO2	14.6
Percent O2	5.4
Percent N2	75.4
Delps Subroutine result	15.93428
DGM Factor	.9924
Pitot Constant	.84

```
   R A D I A N   S O U R C E   T E S T
   E P A   M E T H O D S   2 - 5
   F I N A L   R E S U L T S
PLANT                : SITE 05
PLANT SITE           :
SAMPLING LOCATION    : OUTLET - HCL
TEST #               : 05-HCL-E-02
DATE                 : 02/27/85
TEST PERIOD          : 1306-1506

   PARAMETER                    RESULT
   ---------                    ------

   Vm(dscf)                      51.78572
   Vm(dscm)                      1.466571
   Vw gas(scf)                   24.79619
   Vw gas (scm)                  .702228
   % moisture                    32.37865
   Md                            .6762135
   MWd                           29.264
   MW                            25.61687
   Vs(fpm)                       2470.184
   Vs (mpm)                      753.105
   Flow(acfm)                    279371.8
   Flow(acmm)                    7911.81
   Flow(dscfm)                   129944.2
   Flow(dscmm)                   3680.02
   % I                           112.943
   % EA                          37.227



                                             Program Revision:1/16/84
```

```
          R A D I A N   S O U R C E   T E S T
          E P A   M E T H O D   5
        P A R T I C U L A T E   L O A D I N G
          PLANT                : SITE 05
          PLANT SITE           :
          SAMPLING LOCATION    : OUTLET - HCL
          TEST #               : 05-HCL-E-02
          DATE                 : 02/27/85
          TEST PERIOD          : 1306-1506

      PARAMETER            FRONT-HALF            TRAIN TOTAL
      --------             ----------            -----

      Total Grams          0.0009200             0.0008500
      Grams/dscf           0.0000178             0.0000164
      Grams/acf            0.0000083             0.0000076
      Grains/dscf          0.0002741             0.0002533
      Grains/acf           0.0001275             0.0001178
      Grams/dscm           0.0006273             0.0005796
      Grams/acm            0.0002918             0.0002696
      Pounds/dscf          0.0000000             0.0000000
      Pounds/acf           0.0000000             0.0000000
      Pounds/Hr            0.3054180             0.2821797
      Kilograms/Hr         0.1385367             0.1279959




                                            Program Revision:1/16/84
```

```
    RADIAN SOURCE TEST
    EPA METHOD 2-5
    (RAW DATA)
  PLANT               : SITE 05
  PLANT SITE          :
  SAMPLING LOCATION   : ESP OUTLET
  TEST #              : 05-HCL-E-03
  DATE                : 02/28/85
  TEST PERIOD         : 953-1053

PARAMETER                              VALUE
---------                              -----

Sampling time (min.)                    120
Barometric Pressure (in.Hg)             30.22
Sampling nozzle diameter (in.)          .247
Meter Volume (cu.ft.)                   52.22296
Meter Pressure (in.H2O)                 .6008333
Meter Temperature (F)                   87
Stack dimension (sq.in.)                16286.05
Stack Static Pressure (in.H2O)         -.6
Stack Moisture Collected (gm)           509.7
Absolute stack pressure(in Hg)          30.17588
Average stack temperature (F)           315.5833
Percent CO2                             15.3
Percent O2                              5.3
Percent N2                              75.7
Delps Subroutine result                 15.5216
DGM Factor                              .9924
Pitot Constant                          .84
```

```
    R A D I A N   S O U R C E   T E S T
    E P A   M E T H O D S   2 - 5
    F I N A L   R E S U L T S
PLANT                 : SITE 05
PLANT SITE            :
SAMPLING LOCATION     : ESP OUTLET
TEST #                : 05-HCL-E-03
DATE                  : 02/28/85
TEST PERIOD           : 953-1053

    PARAMETER                  RESULT
    ---------                  ------

    Vm(dscf)                    50.60136
    Vm(dscm)                    1.43303
    Vw gas(scf)                 24.03236
    Vw gas (scm)                .6805963
    % moisture                  32.2004
    Md                          .677996
    MWd                         29.624
    MW                          25.88102
    Vs(fpm)                     2393.105
    Vs (mpm)                    729.6052
    Flow(acfm)                  270654.4
    Flow(acmm)                  7664.932
    Flow(dscfm)                 125992.9
    Flow(dscmm)                 3568.118
    % I                         113.821
    % EA                        36.09175




                                            Program Revision:1/16/84
```

```
           RADIAN  SOURCE  TEST
           EPA  METHOD  5
        PARTICULATE  LOADING
          PLANT              : SITE 05
          PLANT SITE         :
          SAMPLING LOCATION  : ESP OUTLET
          TEST #             : 05-HCL-E-03
          DATE               : 02/28/85
          TEST PERIOD        : 953-1053

PARAMETER         FRONT-HALF         TRAIN TOTAL
--------          ----------         -----

Total Grams       0.0034400          0.0000000
Grams/dscf        0.0000680          0.0000000
Grams/acf         0.0000316          0.0000000
Grains/dscf       0.0010490          0.0000000
Grains/acf        0.0004883          0.0000000
Grams/dscm        0.0024005          0.0000000
Grams/acm         0.0011174          0.0000000
Pounds/dscf       0.0000001          0.0000000
Pounds/acf        0.0000001          0.0000000
Pounds/Hr         1.1331880          0.0000000
Kilograms/Hr      0.5140109          0.0000000

     * BACK-HALF IMPINGER ANALYSIS WAS NOT REQUIRED




                                        Program Revision:1/16/84
```

APPENDIX A-4

MODIFIED METHOD 5 SAMPLE CALCULATIONS

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```
              R A D I A N   S O U R C E   T E S T
              E P A   M E T H O D   2 - 5
              S A M P L E   C A L C U L A T I O N
            PLANT                : SITE-07
            PLANT SITE           :
            SAMPLING LOCATION    : BAGHOUSE INLET
            TEST #               : 07-MM5-BI-01
            DATE                 : 04/16/85
            TEST PERIOD          : 1444-1604 1642-1657 1740-2005

1) Volume of dry gas sampled at standard conditions (68 deg-F ,29.92 in. Hg)

                 Y x Vm x [T(std) + 460] x [Pb +(Pm/13.6)]
     Vm(std) = -----------------------------------------
                      P(std) x (Tm + 460)

                 1.001 x 130.845  x 528 x [ 29.98  + ( 1.066875 /13.6)]
     Vm(std) = ----------------------------------------------
                     29.92    x ( 77.3021  + 460)

     Vm(std) =  129.304dscf

2) Volume of water vapor at standard conditions:

     Vw(gas) =  0.04715 cf/gm x W(l) gm

     Vw(gas) =  0.04715 x  375.2   =  17.691 scf

3) Percent Moisture in stack gas :

                 100 x Vw(gas)
     %M = --------------------
            Vm(std)   + Vw(gas)

                 100 x  17.691
     %M = -------------------- =  12.03 %
           129.304 +   17.691

4) Mole fraction of dry stack gas :

                  100 -    %M          100 -  12.03
     Md   =      ------------      = ------------ =  .8796508
                     100                 100
```

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SAMPLE CALCULATION
PAGE TWO

```
5)Average Molecular Weight of DRY stack gas :

        MWd = (.44 x %CO2) + (.32 x %O2) + (.28 x %N2)

        MWd = (.44 x 7.6 ) + (.32 x 13.3 ) + (.28 x  79.1 ) =  29.748

6)Average Molecular Weight of wet stack gas :

        MW   = MWd x Md + 18(1 - Md)

        MW   = 29.748  x  .8796508  + 18(1 -  .8796508 )  =  28.33414

7) Stack gas velocity in feet-per-minute (fpm) at stack conditions :

Vs = KpxCp x [SQRT (dP)]$ave† x SQRT [Ts $avg†] x SQRT [1/(PsxMW)] x 60sec/

   Vs = 85.49 x .84 x 60 x  19.90611 x SQRT[1/( 29.61971  X  28.33414 )]

   Vs =  2960.649  FPM

8) Average stack gas dry volumetric flow rate (DSCFM) :

            Vs x As x Md x T(std) x Ps
  Qsd =  ---------------------------------------
         144 cu.in./cu.ft. x (Ts +460) x P(std)

          2960.649 x 4320 x .8796508 x528x 29.61971
  Qsd =  ---------------------------------------
          144 x   931.4792  x 29.92

  Qsd =  43842.81 dscfm
```

```
                    S A M P L E   C A L C U L A T I O N
                    P A G E   T H R E E


9)Isokinetic sampling rate (%) :

        Dimensional Constant C = K4 x 60 x 144 x [1 / (Pi  /4)]
        K4 = .0945 FOR ENGLISH UNITS

                   C x Vm(std) x (Ts + 460)
        I% =      -----------------------------------
                  Vs x Tt x Ps x Md x (Dn)*2

                   1039.574 x 129.3039 x 931.4792
        I% = -------------------------------------------
              2960.649 x 240 x 29.61971 x .8796508 x( .254 )*2

        I% =  104.8296

10) Excess air (%) :

                  100 x %O2             100 x 13.3
        EA =      --------------- = ---------------
                  (.264 x %N2) - %O2  (.264 x 79.1 ) - 13.3

        EA =        175.41

11) Particulate Concentration :

        Cs = ( grams part.) / Vm(std) =  0 / 129.3039

        Cs =         0.0000000 Grams/DSCF

                  T(std) x Md x Ps x Cs
        Ca =      ------------------------------
                  P(std) x Ts

                  528 x .8796508  x 29.61971  x       0.0000000
        Ca =      ------------------------------
                  29.92       x      931.4792

        Ca =              0.0000000 Grams/ACF

        LBS/HR =  Cs x 0.002205 x Qsd x 60

        LBS/HR =          0.0000000x 0.002205 x 43842.8 x 60

        LBS/HR = 0

                                                   Program Revision:1/16
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CALCULATIONS - DEFINITIONS
OF TERMS AND SAMPLE CALCULATION

RADIAN SOURCE TEST
EPA METHODS 2-5
DEFINITION OF TERMS

PARAMETER	DEFINITION
Tt(min.)	TOTAL SAMPLING TIME
Dn(in.)	SAMPLING NOZZLE DIAMETER
Ps(in.H20)	ABSOLUTE STACK STATIC GAS PRESSURE
Vm(cu.ft.)	ABSOLUTE VOLUME OF GAS SAMPLE MEASURED BY DGM
Vw(gm.)	TOTAL STACK MOISTURE COLLECTED
Pm(in.H20)	AVERAGE STATIC PRESSURE OF DGM
Tm(F)	AVERAGE TEMPERATURE OF DGM
Pb(in.Hg.)	BAROMETRIC PRESSURE
% CO2	CARBON DIOXIDE CONTENT OF STACK GAS
% O2	OXYGEN CONTENT OF STACK GAS
% N2	NITROGEN CONTENT OF STACK GAS
SQR(DELPS)	AVE. SQ. ROOT OF S-PITOT DIFF. PRESSURE-TEMP. PRODUC
As(sq.in.)	CROSS-SECTIONAL AREA OF STACK(DUCT)
Ts(F)	TEMPERATURE OF STACK
Vm(dscf)	STANDARD VOLUME OF GAS SAMPLED ,Vm(std),AS DRY STD.
Vm(dscm)	STANDARD VOLUME OF GAS SAMPLED,Vm(std),AS DRY STD. C
Vw gas(scf)	VOLUME OF WATER VAPOR IN GAS SAMPLE,STD
% moisture	WATER VAPOR COMPOSITION OF STACK GAS
Md	PROPORTION, BY VOLUME,OF DRY GAS IN GAS SAMPLE
MWd	MOLECULAR WEIGHT OF STACK GAS,DRY BASIS LB/LB-MOLE
MW	MOLECULAR WEIGHT OF STACK GAS,WET BASIC LB/LB-MOLE
Vs(fpm)	AVERAGE STACK GAS VELOCITY
Flow(acfm)	AVERAGE STACK GAS FLOW RATE(ACTUAL STACK COND.)
Flow(acmm)	AVERAGE STACK GAS FLOW RATE(ACTUAL STACK COND.)
Flow(dscfm)	AVERAGE STACK GAS VOLUMETRIC FLOW RATE(DRY BASIS)
Flow(dscmm)	AVERAGE STACK GAS VOLUMETRIC FLOW RATE(DRY BASIS)
% I	PERCENT ISOKINETIC
% EA	PERCENT EXCESS AIR IN STACK GAS
DGM	DRY GAS METER
Y	DRY GAS METER CORRECTION FACTOR
Pg	STACK STATIC GAS PRESSURE
Cp	PITOT COEFFICIENT
dH	ORIFICE PLATE DIFF. PRESS. VALUE
dP	PITOT DIFF. PRESS. VALUE
*** EPA STANDARD CONDITIONS	Temperature = 68 deg-F (528 deg-R) Pressure = 29.92 in. Hg.

APPENDIX B

SAMPLE SHIPMENT LETTERS

March 1,1985

U. S. EPA ECC Toxicant Analysis Center
Building 1105
Bay St. Louis, MS 39529

Attention: Danny McDaniel

Subject: Tier 4 - Analysis Instructions

Dear Sir:

The objective of this letter is to clarify instructions and priorities for individual samples from specific Tier 4 combustion sites. This instruction letter is No. 5 and pertains to EPA Site No. 05 at Brunswick GA.

The Episode No. is 2612, and SCC numbers assigned to this site were numbers DQ001400 through DQ001499.

SCC numbers DQ001401 through DQ001406 have been assigned to Troika for internal QA/QC purposes. SCC numbers DQ001407 through DQ001422 have been assigned to samples included in this shipment and number DQ001418 have been assigned to samples being archived at Radian. All remaining SCC numbers are unused.

The sample shipment for EPA Site No. 05 consists of 6 boxes containing 57 samples in 65 containers.(Note-The Modified Method 5 samples are comprised of 6 components as listed below.Some MM5 sample runs have more than one container per component as indicated by asterisk.) The sample shipment was shipped air freight on March 1st,1985 by Federal Express under Airbill(s) No.770332511 and No.544545466

Instructions for extraction and analysis follow.

1. The following samples require immediate extraction and analysis (Priority #1 samples).

   Radian Run #05-MM5-E-01
   (Total of 6 train components)

SCC #	Component	Fraction
DQ001408	1	Filter
DQ001408	2*(2 containers)	Probe Rinse
DQ001408	3	Back Half/Coil Rinse
DQ001408	4	Condensate
DQ001408	5	Impinger Solution
DQ001408	6	XAD Module

Radian Run # 05-MM5-D-01
(Total of 6 train components)

SCC #	Components	Fraction
DQ001409	1	Filter
DQ001409	2	Probe Rinse
DQ001409	3	Back Half/Coil Rinse
DQ001409	4	Condensate
DQ001409	5	Impinger Solution
DQ001409	6	XAD Module

Radian Run # 05-MM5-D-02
(Total of 6 train components)

SCC #	Components	Fraction
DQ001411	1	Filter
DQ001411	2	Probe Rinse
DQ001411	3	Back Half/Coil Rinse
DQ001411	4*(2 container)	Condensate
DQ001411	5*(2 container)	Impinger Solution
DQ001411	6	XAD Module

Radian Run #05-MM5-E-BL
(Total of 6 train components)

SCC #	Components	Fraction
DQ001412	1	Filter
DQ001412	2	Probe Rinse
DQ001412	3	Back Half/Coil Rinse
DQ001412	4	Condensate
DQ001412	5	Impinger Solution
DQ001412	6	XAD Module

Radian Run # 05-MM5-D-BL
(Total of 6 train components)

SCC #	Components	Fraction
DQ001413	1	Filter
DQ001413	2	Probe Rinse
DQ001413	3	Back Half/Coil Rinse
DQ001413	4	Condensate
DQ001413	5	Impinger Solution
DQ001413	6	XAD Module

Radian Run # 05-MM5-E-02
(Total of 6 train components)

SCC #	Components	Fraction
DQ001414	1	Filter
DQ001414	2*(2 containers)	Probe Rinse
DQ001414	3	Back Half/Coil Rinse
DQ001414	4*(2 containers)	Condensate
DQ001414	5	Impinger Solution
DQ001414	6	XAD Module

Radian Run # 05-MM5-D-03
(Total of 6 train components)

SCC #	Components	Fraction
DQ001415	1	Filter
DQ001415	2	Probe Rinse
DQ001415	3	Back Half/Coil Rinse
DQ001415	4*(2 containers)	Condensate
DQ001415	5*(2 containers)	Impinger Solution
DQ001415	6	XAD Module

Radian Run # 05-MM5-E-03
(Total of 6 train components)

SCC #	Components	Fraction
DQ001416	1	Filter
DQ001416	2	Probe Rinse
DQ001416	3	Back Half/Coil Rinse
DQ001416	4*(2 containers)	Condensate
DQ001416	5	Impinger Solution
DQ001416	6	XAD Module

Radian train proof (cleaned unused field sampling glassware train components.) The proof train consists of the following fractions:

SCC #	COMPOMENT	FRACTION
DQ001419	2-5	Methylene Chloride Rinse
DQ001419	1	Hexane Extracted Filters (2)
DQ001419	6	Sorbent Module

The following field solvent blanks are also included for priority 1 analysis.

DQ001421	05-ACETONE-FBL-A	Acetone
DQ001422	05-H20-FBL-A	HPLC Water
DQ001420	05-MeCL-FBL-A	Methylene Chloride

2. The strong black liquor samples are the only Priority #2 samples. They should be held for analysis by Troika pending the results of Priority #1 sample analysis.

SCC #	Sample	
DQ001407	05-SBL-01-A	Strong black liquor
DQ001410	05-SBL-02-A	Strong black liquor
DQ001417	05-SBL-03-A	Strong black liquor

3. The soil sample is the only Priority #3 sample. It will be held by Radian for analysis by Troika pending the results of Priority #1 and Priority #2 sample analyses.

SCC #	Sample	
DQ001418	# 05-S-A	Soils

If there are any questions concerning this sample shipment, please contact either Bob Jongleux or Winton Kelly at Radian Corporation (919) 481-0212 or (919)-541-9100.

Sincerely,

Robert Jongleux

TEST TEAM LEADER

cc.E. Hanks-EPA/AMTB
A. Miles-Radian

APPENDIX C

DIOXIN/FURAN ANALYTICAL DATA FOR MODIFIED METHOD 5 TRAINS

TABLE C-1. DIOXIN/FURAN ANALYTICAL DATA FOR MM5 TRAINS (INLET)

Isomer/Homolgue	Amount Detected, Picograms Per Sample Train[a]		
	Run 01	Run 02	Run 03
Dioxins			
2378 TCDD	0	0	0
Other TCDD	0	0	0
Penta CDD	0	0	0
Hexa CDD	0	0	600
Hepta CDD	400	2100	19600
Octa CDD	1600	6700	98600
Total PCDD	2000	8800	118800
Furans			
2378 TCDF	100	0	200
Other TCDF	100	0	1300
Penta CDF	0	0	0
Hexa CDF	200	300	700
Hepta CDF	100	1000	1800
Octa CDF	100	700	1300
Total PCDF	600	2000	5300

[a] Value = amount detected in MM5 sample train.

TABLE C-2. DIOXIN/FURAN ANALYTICAL DATA FOR MM5 TRAINS (OUTLET)

Isomer/Homolgue	Amount Detected, Picograms Per Sample Train[a] Run 01	Run 02	Run 03
Dioxins			
2378 TCDD	0	0	0
Other TCDD	0	0	0
Penta CDD	0	0	0
Hexa CDD	500	0	300
Hepta CDD	900	700	700
Octa CDD	2800	2300	2400
Total PCDD	4200	3000	3400
Furans			
2378 TCDF	0	0	100
Other TCDF	700	0	300
Penta CDF	0	0	0
Hexa CDF	1900	0	600
Hepta CDF	700	300	400
Octa CDF	200	200	200
Total PCDF	3500	500	1600

[a] Value = amount detected in MM5 sample train.

APPENDIX D

RUN-SPECIFIC DIOXIN/FURAN EMISSIONS DATA

APPENDIX D-1

AS-MEASURED CONCENTRATIONS

TABLE D-1. DIOXIN/FURAN EMISSIONS DATA FOR RUN 1, SITE BLB-B INLET

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	ND (3.95E-02)	ND (2.95E-03)	ND (8.69E+00)
Other TCDD	ND (3.95E-02)	ND (2.95E-03)	ND (8.69E+00)
Penta-CDD	ND (3.95E-02)	ND (2.67E-03)	ND (8.69E+00)
Hexa-CDD	ND (3.95E-02)	ND (2.43E-03)	ND (8.69E+00)
Hepta-CDD	1.75E-01(N/A)	9.93E-03(N/A)	3.86E+01
Octa-CDD	7.02E-01(N/A)	3.67E-02(N/A)	1.54E+02
Total PCDD	8.77E-01	4.66E-02	1.93E+02
FURANS			
2378 TCDF	4.39E-02(N/A)	3.45E-03(N/A)	9.65E+00
Other TCDF	4.39E-02(N/A)	3.45E-03(N/A)	9.65E+00
Penta-CDF	ND (1.05E-01)	ND (7.45E-03)	ND (2.32E+01)
Hexa-CDF	8.77E-02(N/A)	5.63E-03(N/A)	1.93E+01
Hepta-CDF	4.39E-02(N/A)	2.58E-03(N/A)	9.65E+00
Octa-CDF	4.39E-02(N/A)	2.38E-03(N/A)	9.65E+00
Total PCDF	2.63E-01	1.75E-02	5.79E+01

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

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TABLE D-2. DIOXIN/FURAN EMISSIONS DATA FOR RUN 2, SITE BLB-B INLET

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	ND (6.25E-02)	ND (4.67E-03)	ND (1.40E+01)
Other TCDD	ND (6.25E-02)	ND (4.67E-03)	ND (1.40E+01)
Penta-CDD	ND (6.94E-03)	ND (4.69E-04)	ND (1.56E+00)
Hexa-CDD	ND (8.68E-02)	ND (5.34E-03)	ND (1.95E+01)
Hepta-CDD	7.29E-01(N/A)	4.13E-02(N/A)	1.64E+02
Octa-CDD	2.33E+00(N/A)	1.22E-01(N/A)	5.23E+02
Total PCDD	3.06E+00	1.63E-01	6.87E+02
FURANS			
2378 TCDF	ND (6.25E-02)	ND (4.91E-03)	ND (1.40E+01)
Other TCDF	ND (6.25E-02)	ND (4.91E-03)	ND (1.40E+01)
Penta-CDF	ND (3.47E-02)	ND (2.46E-03)	ND (7.80E+00)
Hexa-CDF	1.04E-01(N/A)	6.68E-03(N/A)	2.34E+01
Hepta-CDF	3.47E-01(N/A)	2.04E-02(N/A)	7.80E+01
Octa-CDF	2.43E-01(N/A)	1.32E-02(N/A)	5.46E+01
Total PCDF	6.94E-01	4.03E-02	1.56E+02

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

TABLE D-3. DIOXIN/FURAN EMISSIONS DATA FOR RUN 3, SITE BLB-B INLET

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Concentration In Flue Gas (ppt)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	ND (2.43E-02)	ND (1.82E-03)	ND (5.46E+00)
Other TCDD	ND (2.43E-02)	ND (1.82E-03)	ND (5.46E+00)
Penta-CDD	ND (8.68E-02)	ND (5.87E-03)	ND (1.95E+01)
Hexa-CDD	2.08E-01(N/A)	1.28E-02(N/A)	4.68E+01
Hepta-CDD	6.81E+00(N/A)	3.85E-01(N/A)	1.53E+03
Octa-CDD	3.42E+01(N/A)	1.79E+00(N/A)	7.69E+03
Total PCDD	4.13E+01	2.19E+00	9.27E+03
FURANS			
2378 TCDF	6.94E-02(N/A)	5.46E-03(N/A)	1.56E+01
Other TCDF	4.51E-01(N/A)	3.55E-02(N/A)	1.01E+02
Penta-CDF	ND (8.68E-02)	ND (6.14E-03)	ND (1.95E+01)
Hexa-CDF	2.43E-01(N/A)	1.56E-02(N/A)	5.46E+01
Hepta-CDF	6.25E-01(N/A)	3.68E-02(N/A)	1.40E+02
Octa-CDF	4.51E-01(N/A)	2.45E-02(N/A)	1.01E+02
Total PCDF	1.84E+00	1.18E-01	4.13E+02

NOTE: Isomer concentrations shown are at as-measured oxygen conditions.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

APPENDIX D-2

CONCENTRATIONS CORRECTED TO 3 PERCENT OXYGEN

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TABLE D-4. DIOXIN/FURAN EMISSIONS DATA FOR RUN 1, SITE BLB-B INLET
(Concentrations Corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	ND (4.15E-02)	ND (3.10E-03)	ND (8.69E+00)
Other TCDD	ND (4.15E-02)	ND (3.10E-03)	ND (8.69E+00)
Penta-CDD	ND (4.15E-02)	ND (2.80E-03)	ND (8.69E+00)
Hexa-CDD	ND (4.15E-02)	ND (2.55E-03)	ND (8.69E+00)
Hepta-CDD	1.84E-01(N/A)	1.04E-02(N/A)	3.86E+01
Octa-CDD	7.37E-01(N/A)	3.86E-02(N/A)	1.54E+02
Total PCDD	9.22E-01	4.90E-02	1.93E+02
FURANS			
2378 TCDF	4.61E-02(N/A)	3.62E-03(N/A)	9.65E+00
Other TCDF	4.61E-02(N/A)	3.62E-03(N/A)	9.65E+00
Penta-CDF	ND (1.11E-01)	ND (7.83E-03)	ND (2.32E+01)
Hexa-CDF	9.22E-02(N/A)	5.91E-03(N/A)	1.93E+01
Hepta-CDF	4.61E-02(N/A)	2.71E-03(N/A)	9.65E+00
Octa-CDF	4.61E-02(N/A)	2.50E-03(N/A)	9.65E+00
Total PCDF	2.77E-01	1.84E-02	5.79E+01

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

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TABLE D-5. DIOXIN/FURAN EMISSIONS DATA FOR RUN 2, SITE BLB-B INLET
(Concentrations Corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	ND (6.90E-02)	ND (5.16E-03)	ND (1.40E+01)
Other TCDD	ND (6.90E-02)	ND (5.16E-03)	ND (1.40E+01)
Penta-CDD	ND (7.67E-03)	ND (5.18E-04)	ND (1.56E+00)
Hexa-CDD	ND (9.59E-02)	ND (5.90E-03)	ND (1.95E+01)
Hepta-CDD	8.05E-01(N/A)	4.56E-02(N/A)	1.64E+02
Octa-CDD	2.57E+00(N/A)	1.34E-01(N/A)	5.23E+02
Total PCDD	3.37E+00	1.80E-01	6.87E+02
FURANS			
2378 TCDF	ND (6.90E-02)	ND (5.43E-03)	ND (1.40E+01)
Other TCDF	ND (6.90E-02)	ND (5.43E-03)	ND (1.40E+01)
Penta-CDF	ND (3.83E-02)	ND (2.71E-03)	ND (7.80E+00)
Hexa-CDF	1.15E-01(N/A)	7.38E-03(N/A)	2.34E+01
Hepta-CDF	3.83E-01(N/A)	2.26E-02(N/A)	7.80E+01
Octa-CDF	2.68E-01(N/A)	1.45E-02(N/A)	5.46E+01
Total PCDF	7.67E-01	4.45E-02	1.56E+02

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

TABLE D-6. DIOXIN/FURAN EMISSIONS DATA FOR RUN 3, SITE BLB-B INLET (Concentrations Corrected to 3% Oxygen)

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm @ 3% oxygen)	Isomer Concentration In Flue Gas (ppt @ 3% oxygen)	Isomer Hourly Emissions Rate (ug/hr)
DIOXINS			
2378 TCDD	ND (2.77E-02)	ND (2.07E-03)	ND (5.46E+00)
Other TCDD	ND (2.77E-02)	ND (2.07E-03)	ND (5.46E+00)
Penta-CDD	ND (9.89E-02)	ND (6.68E-03)	ND (1.95E+01)
Hexa-CDD	2.37E-01(N/A)	1.46E-02(N/A)	4.68E+01
Hepta-CDD	7.75E+00(N/A)	4.39E-01(N/A)	1.53E+03
Octa-CDD	3.90E+01(N/A)	2.04E+00(N/A)	7.69E+03
Total PCDD	4.70E+01	2.49E+00	9.27E+03
FURANS			
2378 TCDF	7.91E-02(N/A)	6.22E-03(N/A)	1.56E+01
Other TCDF	5.14E-01(N/A)	4.04E-02(N/A)	1.01E+02
Penta-CDF	ND (9.89E-02)	ND (7.00E-03)	ND (1.95E+01)
Hexa-CDF	2.77E-01(N/A)	1.78E-02(N/A)	5.46E+01
Hepta-CDF	7.12E-01(N/A)	4.19E-02(N/A)	1.40E+02
Octa-CDF	5.14E-01(N/A)	2.79E-02(N/A)	1.01E+02
Total PCDF	2.10E+00	1.34E-01	4.13E+02

NOTE: Isomer concentrations shown are corrected to 3% oxygen.

ND = Not detected (detection limit in parentheses).
N/A = Not applicable. QA samples indicate the method capabilities and minimum limits of detection when values are positive.
ng = 1.0E-09g
ug = 1.0E-06g
ppt = parts per trillion, dry volume basis
8760 operating hours per year

APPENDIX E

RUN-SPECIFIC RISK MODELING INPUT DATA

APPENDIX E-1

ESP INLET

TABLE E-1. RISK MODELING PARAMETERS FOR RUN 1, SITE BLB-B INLET

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	ND (3.95E-02)	ND (8.69E+00)	1.000	ND (7.61E+01)
Other TCDD	ND (3.95E-02)	ND (8.69E+00)	.010	ND (7.61E-01)
2378 TCDF	4.39E-02	9.65E+00	.100	8.46E+00
Other TCDF	4.39E-02	9.65E+00	.001	8.46E-02
Penta-CDD	ND (3.95E-02)	ND (8.69E+00)	.500	ND (3.80E+01)
Penta-CDF	ND (1.05E-01)	ND (2.32E+01)	.100	ND (2.03E+01)
Hexa-CDD	ND (3.95E-02)	ND (8.69E+00)	.040	ND (3.04E+00)
Hexa-CDF	8.77E-02	1.93E+01	.010	1.69E+00
Hepta-CDD	1.75E-01	3.86E+01	.001	3.38E-01
Hepta-CDF	4.39E-02	9.65E+00	.001	8.46E-02
Octa-CDD	7.02E-01	1.54E+02	.000	.00E+00
Octa-CDF	4.39E-02	9.65E+00	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				1.07E+01

ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
8760 operating hours per year

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TABLE E-2. RISK MODELING PARAMETERS FOR RUN 2, SITE BLB-B INLET

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	ND (6.25E-02)	ND (1.40E+01)	1.000	ND (1.23E+02)
Other TCDD	ND (6.25E-02)	ND (1.40E+01)	.010	ND (1.23E+00)
2378 TCDF	ND (6.25E-02)	ND (1.40E+01)	.100	ND (1.23E+01)
Other TCDF	ND (6.25E-02)	ND (1.40E+01)	.001	ND (1.23E-01)
Penta-CDD	ND (6.94E-03)	ND (1.56E+00)	.500	ND (6.83E+00)
Penta-CDF	ND (3.47E-02)	ND (7.80E+00)	.100	ND (6.83E+00)
Hexa-CDD	ND (8.68E-02)	ND (1.95E+01)	.040	ND (6.83E+00)
Hexa-CDF	1.04E-01	2.34E+01	.010	2.05E+00
Hepta-CDD	7.29E-01	1.64E+02	.001	1.44E+00
Hepta-CDF	3.47E-01	7.80E+01	.001	6.83E-01
Octa-CDD	2.33E+00	5.23E+02	.000	.00E+00
Octa-CDF	2.43E-01	5.46E+01	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				4.17E+00

ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
8760 operating hours per year

TABLE E-3. RISK MODELING PARAMETERS FOR RUN 3, SITE BLB-B INLET

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	ND (2.43E-02)	ND (5.46E+00)	1.000	ND (4.78E+01)
Other TCDD	ND (2.43E-02)	ND (5.46E+00)	.010	ND (4.78E-01)
2378 TCDF	6.94E-02	1.56E+01	.100	1.37E+01
Other TCDF	4.51E-01	1.01E+02	.001	8.88E-01
Penta-CDD	ND (8.68E-02)	ND (1.95E+01)	.500	ND (8.54E+01)
Penta-CDF	ND (8.68E-02)	ND (1.95E+01)	.100	ND (1.71E+01)
Hexa-CDD	2.08E-01	4.68E+01	.040	1.64E+01
Hexa-CDF	2.43E-01	5.46E+01	.010	4.78E+00
Hepta-CDD	6.81E+00	1.53E+03	.001	1.34E+01
Hepta-CDF	6.25E-01	1.40E+02	.001	1.23E+00
Octa-CDD	3.42E+01	7.69E+03	.000	.00E+00
Octa-CDF	4.51E-01	1.01E+02	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				5.04E+01

ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
8760 operating hours per year

APPENDIX E-2

ESP OUTLET

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TABLE E-4. RISK MODELING PARAMETERS FOR RUN 1, SITE BLB-B OUTLET

Latitude = 31 10 23
Longitude = 81 31 13
Stack Height (From Grade Level) = 84.7
Stack Diameter (ID) = 3.66
Flue Gas Flow Rate (Dry Standard) = 3750.4
Flue Gas Exit Temperature = 431.6
Flue Gas Exit Velocity (Actual) = 766.17

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	ND (3.01E-02)	ND (6.77E+00)	1.000	ND (5.93E+01)
Other TCDD	ND (3.01E-02)	ND (6.77E+00)	.010	ND (5.93E-01)
2378 TCDF	ND (3.76E-02)	ND (8.46E+00)	.100	ND (7.41E+00)
Other TCDF	2.63E-01	5.92E+01	.001	5.19E-01
Penta-CDD	ND (4.51E-02)	ND (1.02E+01)	.500	ND (4.45E+01)
Penta-CDF	ND (2.74E-01)	ND (6.18E+01)	.100	ND (5.41E+01)
Hexa-CDD	1.88E-01	4.23E+01	.040	1.48E+01
Hexa-CDF	7.14E-01	1.61E+02	.010	1.41E+01
Hepta-CDD	3.38E-01	7.61E+01	.001	6.67E-01
Hepta-CDF	2.63E-01	5.92E+01	.001	5.19E-01
Octa-CDD	1.05E+00	2.37E+02	.000	.00E+00
Octa-CDF	7.52E-02	1.69E+01	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				3.06E+01

ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
8760 operating hours per year

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TABLE E-5. RISK MODELING PARAMETERS FOR RUN 2, SITE BLB-B OUTLET

Latitude = 31 10 23
Longitude = 81 31 13
Stack Height (From Grade Level) = 84.7
Stack Diameter (ID) = 3.66
Flue Gas Flow Rate (Dry Standard) = 3694.5
Flue Gas Exit Temperature = 426.7
Flue Gas Exit Velocity (Actual) = 755.1

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	ND (1.18E-02)	ND (2.61E+00)	1.000	ND (2.28E+01)
Other TCDD	ND (1.18E-02)	ND (2.61E+00)	.010	ND (2.28E-01)
2378 TCDF	ND (4.00E-02)	ND (8.87E+00)	.100	ND (7.77E+00)
Other TCDF	ND (4.00E-02)	ND (8.87E+00)	.001	ND (7.77E-02)
Penta-CDD	ND (3.29E-02)	ND (7.30E+00)	.500	ND (3.20E+01)
Penta-CDF	ND (3.29E-02)	ND (7.30E+00)	.100	ND (6.40E+00)
Hexa-CDD	ND (8.47E-02)	ND (1.88E+01)	.040	ND (6.58E+00)
Hexa-CDF	ND (1.36E-01)	ND (3.03E+01)	.010	ND (2.65E+00)
Hepta-CDD	1.65E-01	3.65E+01	.001	3.20E-01
Hepta-CDF	7.06E-02	1.56E+01	.001	1.37E-01
Octa-CDD	5.41E-01	1.20E+02	.000	.00E+00
Octa-CDF	4.71E-02	1.04E+01	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				4.57E-01

ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
8760 operating hours per year

TABLE E-6. RISK MODELING PARAMETERS FOR RUN 3, SITE BLB-B OUTLET

Latitude = 31 10 23
Longitude = 81 31 13
Stack Height (From Grade Level) = 84.7
Stack Diameter (ID) = 3.66
Flue Gas Flow Rate (Dry Standard) = 3885.3
Flue Gas Exit Temperature = 432.4
Flue Gas Exit Velocity (Actual) = 783.6

Dioxin/Furan Isomer	Isomer Concentration In Flue Gas (ng/dscm)	Isomer Hourly Emissions Rate (ug/hr)	Relative Potency Factor	2,3,7,8 - TCDD Equivalent Emissions (mg/yr)
2378 TCDD	ND (2.49E-02)	ND (5.80E+00)	1.000	ND (5.08E+01)
Other TCDD	ND (2.49E-02)	ND (5.80E+00)	.010	ND (5.08E-01)
2378 TCDF	2.26E-02	5.27E+00	.100	4.62E+00
Other TCDF	6.79E-02	1.58E+01	.001	1.39E-01
Penta-CDD	ND (1.36E-01)	ND (3.16E+01)	.500	ND (1.39E+02)
Penta-CDF	ND (1.36E-01)	ND (3.16E+01)	.100	ND (2.77E+01)
Hexa-CDD	6.79E-02	1.58E+01	.040	5.54E+00
Hexa-CDF	1.36E-01	3.16E+01	.010	2.77E+00
Hepta-CDD	1.58E-01	3.69E+01	.001	3.23E-01
Hepta-CDF	9.05E-02	2.11E+01	.001	1.85E-01
Octa-CDD	5.43E-01	1.27E+02	.000	.00E+00
Octa-CDF	4.52E-02	1.05E+01	.000	.00E+00
Net 2378 TCDD Equivalent Atmospheric Loading				1.36E+01

ND = not detected (detection limit in parentheses).
N/A = detection limit not available
ng = 1.0E-09g
ug = 1.0E-06g
mg = 1.0E-03g
Standard conditions: 293 K (20 C) temperature and 1 atmosphere pressure.
8760 operating hours per year

APPENDIX F

COMPOUND-SPECIFIC PRECURSOR RESULTS

TABLE F-1. COMPOUND-SPECIFIC DIOXIN PRECURSOR DATA FOR SITE 05 FEED SAMPLES

Precursor Compounds	Precursor Concentration, ug/g (ppm)		
	Black Liquor Feed		
	Run 01	Run 02	Run 03
Base Neutrals Fraction			
Chlorinated Benzenes:			
Dichlorobenzenes	ND	ND	ND
Trichlorobenzenes	ND	ND	ND
Tetrachlorobenzenes	ND	ND	ND
Pentachlorobenzenes	ND	ND	ND
Hexachlorobenzenes	ND	ND	ND
Total Chlorinated Benzenes	0	0	0
Chlorinated Biphenyls:			
Chlorobiphenyls	ND	ND	ND
Dichlorobiphenyls	ND	ND	ND
Trichlorobiphenyls	ND	ND	ND
Tetrachlorobiphenyls	ND	ND	ND
Pentachlorobiphenyls	ND	ND	ND
Hexachlorobiphenyls	ND	ND	ND
Heptachlorobiphenyls	ND	ND	ND
Octachlorobiphenyls	ND	ND	ND
Nonachlorobiphenyls	ND	ND	ND
Decachlorobiphenyls	ND	ND	ND
Total Chlorinated Biphenyls	0	0	0
Acids Fraction			
Chlorinated Phenols:			
Dichlorophenols	ND	ND	ND
Trichlorophenols	ND	ND	ND
Tetrachlorophenols	ND	ND	ND
Pentachlorophenols	ND	trace	ND
Total Chlorinated Phenols	0	trace	0

ND = not detected

See Section 8.3 for a discussion of quality assurance/quality control results for these analyses.

APPENDIX G

RESEARCH TRIANGLE INSTITUTE (RTI) AUDIT REPORT

QUALITY ASSURANCE AUDIT FOR TIER 4 OF THE NATIONAL DIOXIN STUDY: BLACK LIQUOR RECOVERY BOILER, SITE BLB-B

by

Donna J. Holder
Richard V. Crume

EPA Contract No. 68-02-3149
Work Assignment 10-1

RTI Project No. 472U-2500-48

EPA Technical Project Monitor
D. Oberacker

Prepared for

William B. Kuykendal, Air Management Technology Branch
Monitoring and Data Analysis Division
Office of Air Quality Planning and Standards
Environmental Protection Agency
Research Triangle Park, NC 27711

April 1985

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3	Reference Materials Used to Evaluate the Radian Test Program.	10

1.0 SUMMARY

On February 27, 1985, Research Triangle Institute (RTI) performed a quality assurance (QA) audit of an emission test program underway at a black liquor recovery boiler (Site BLB-B). The emission test program was one of a series of tests performed by Radian Corporation for the U.S. Environmental Protection Agency (EPA). The data collected during these tests will be added to the data base supporting Tier 4 of EPA's National Dioxin Study. The primary objective of Tier 4 is to determine if various combustion sources are sources of dioxin emissions. If any of the combustion sources are found to emit dioxin, the secondary objectives of Tier 4 are to quantify these dioxin emissions and, if possible, to relate these emissions to combustion device operating conditions. The audit was performed by Richard V. Crume and Donna J. Holder, both environmental engineers with RTI. The EPA project officer is William B. Kuykendal of the Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina. A list of persons during the audit is presented in Table 1.

The goals of the audit were to: (1) evaluate Radian Corporation's adherence to the test program's Test Plan and QA Plan and (2) determine whether the recommendations made by RTI as a result of an earlier audit had been fully implemented. (The earlier audit took place on November 8, 1984, and involved an evaluation of Radian Corporation's testing at industrial incinerator site ISW-A.)[1] As with the earlier audit, the RTI auditors were impressed with the Radian test team and the quality of their work. It appeared that the test team faithfully adhered to their Test Plan and QA Plan and that the required sampling procedures were carefully followed. Furthermore, with two minor exceptions (the position of the condenser on the Modified Method 5 sampling train and the marking of liquid levels on bottles), all of RTI's earlier recommendations had been implemented. RTI is satisfied that the Radian test team continues to generate quality data.

This audit report does not include an evaluation of Radian's analytical facilities, which is expected to take place within the next 3 months. Con-

TABLE 1. LIST OF PERSONS PRESENT DURING THE RTI AUDIT

Name	Affiliation
Mike Palazzolo	Radian (Test team leader)
Dave Dayton	Radian Corporation
Lee Garcia	Radian Corporation
Gary Henry	Radian Corporation
Carol Jamgochian	Radian Corporation
Bob Jongleux	Radian Corporation
Winton Kelly	Radian Corporation
Jim McReynolds	Radian Corporation
Dave Savia	Radian Corporation
Bob Mournigham	EPA (Cincinnati)
Richard Crume	Research Triangle Institute
Donna Holder	Research Triangle Insitute

clusions regarding the entire Radian test program cannot be made until the analytical laboratory audit has been completed.

2.0 INTRODUCTION

2.1 PROCESS DESCRIPTION

The process unit under study during the Site BLB-B test program was a Combustion Engineering recovery boiler with a rated capacity of 900 tons per day (TPD) of unbleached pulp. The boiler typically operates at full load, 24 hours per day. The black liquor fed to the boiler has a solids content of approximately 67 percent, by weight, and a heating value of approximately 6,000 Btu/lb. Various materials make up the strong black liquor, including:

- Wood chips,
- Makeup salt cake,
- Slaked lime [$Ca(OH)_2$],
- ClO_2 spent acid,
- ClO_2 byproduct salt cake, and
- Well water (process makeup).

The concentrated black liquor is at an approximate temperature of 250 °F as it enters the combustion zone of the boiler.

Forced draft fans supply primary and secondary combustion air to the boiler. The oxygen concentration in the outlet flue gas is manually maintained at between 3.0 and 4.0 percent. Prior to being vented to the stack, the exhaust gases from the black liquor boiler pass through a two-chamber Flakt electrostatic precipitator (ESP) for particulate removal by drag- and screw-type conveyors. The ESP outlet has a design particulate removal efficiency of 99.6 percent. More details concerning the black liquor recovery boiler can be found in Radian Corporation's Test Plan.[2]

2.2 TEST PROGRAM DESIGN

The test program can be divided into the following categories:

- Process monitoring,
- Modified Method 5 (MM5) sampling train,
- Blank MM5 sampling train,
- HCl sampling train,
- Continuous emission monitors,
- Process samples,
- Sample handling, transportation, and storage, and
- Soil sampling.

Details concerning these operations can be found in Radian Corporation's Test Plan,[2] Quality Assurance Project Plan,[3] and Sampling Procedures Document.[4]

The most important aspect of the test program concerns the sampling of organic compounds (including any 2,3,7,8-TCDD present in the gas stream) using an MM5 sampling train. The MM5 train is similar to the EPA Method 5 train, except that a sorbent trap for the collection of vapor phase organics is included. The trap consists of separate sections for cooling the gas stream and for absorbing the organic compounds onto Amberlite XAD-2 resin. The setup and operation of the MM5 train are described in detail in the "ASME MM5 Sampling Methodology for Chlorinated Organics," contained in Radian Corporation's Test Plan.[2] Three test runs, each of approximately 4 hours' duration, were to be conducted at the test site.

2.3 AUDIT OBJECTIVES

The goals of the audit were to evaluate Radian Corporation's adherence to the test program's Test Plan and QA Plan and to determine whether the recommendations made by RTI as a result of an earlier audit had been fully implemented. These goals were achieved by performing two types of audit activities: systems audits and performance audits.

A systems audit consists of an onsite inspection and review of the test procedures (including any QA activities) associated with test program measurements. RTI's systems audit of the Radian test began with an evaluation of Radian's QA project plan. This plan was evaluated according to the criteria presented in EPA's QAMS-005/80 guideline document and summarized in Table 2.[5]

TABLE 2. CRITICAL QUALITY ASSURANCE ELEMENTS

Project Description

- Project description
- Experimental design
- Intended use of acquired data
- Start and completion dates
- Appropriate diagrams, tables, and figures

Project Organization and Responsibility

- Organization of project
- Line of authority
- Key individuals (including quality assurance official)

Quality Assurance Objectives for Measurement Data

- Precision
- Accuracy
- Completeness
- Representativeness
- Comparability

Sampling Procedures

- Sampling site selection
- Sampling procedures
- Description of containers for sample collection, preservation, transport, and storage
- Procedures to avoid sample contamination
- Sample preservation methods and holding times
- Procedures for recording sample history, sampling conditions, and analyses to be performed

Sample Custody Records

- Preparation of reagents or supplies associated with sample
- Location and conditions where sample was taken
- Sample preservation methods
- Labeling
- Field tracking forms
- Field and laboratory sample custodians
- Laboratory custody log
- Laboratory handling, storage, and dispersement procedures

(continued)

TABLE 2. (continued)

Calibration Procedures

- Description of, or reference to, calibration procedure
- Frequency of calibration
- Calibration standards, including sources and traceability procedures

Analytical Procedures

- Analytical procedure
- Appropriateness of method

Data Reduction, Validation and Reporting

- Data reduction scheme
- Equations to be used
- Validation procedures
- Identification and treatment of outliers

Internal Quality Control Checks

- Replicates
- Spiked samples
- Split samples
- Control charts
- Blanks
- Zero and span gases
- Quality control samples
- Surrogate samples
- Reagent checks
- Calibration standards and devices

Performance and Systems Audits

- Schedule for conducting audits
- Systems to be audited
- Sources of audit materials

Procedures to Assess Data Precision, Accuracy and Completeness

- Central tendency and dispersion
- Measures of variability
- Significance test
- Confidence limits
- Testing for outliers

Preventive Maintenance

- Schedule of maintenance tasks
- List of critical spare parts on hand

(continued)

TABLE 2. (continued)

Corrective Action

- Predetermined limits for data acceptability
- Procedures for corrective action
- Responsible individuals

Quality Assurance Reports to Management

- Frequency of reporting
- Responsible individuals
- Significant problems and recommended solutions

Radian's test plan was similarly evaluated, although adherence to the QAMS-005/80 criteria was not required. RTI's comments on the Radian QA and Test Plans were previously submitted.[6] [7] [8] The systems audit continued with an onsite inspection of the Radian test program and the preparation of this report. The systems audit also included the determination of whether RTI's earlier recommendations were implemented and whether RTI's comments on the Test Plan were addressed. (An onsite systems audit of Radian's analytical laboratory will be performed in 1985. The results of the laboratory audit will be presented in a separate report.)

The objectives of a performance audit are similar to those of a systems audit (i.e., to evaluate the quality of data likely to be generated by the test or experimental program). The performance audit differs from the systems audit in that it involves the actual measurement of critical test program parameters using standardized reference materials. RTI's performance audit of the Radian test program utilized the materials listed in Table 3. Radian Corporation and EPA's Troika Laboratories will analyze these materials and return the results to RTI for evaluation. Once these results are received and evaluated, RTI will discuss the results in a separate report.

TABLE 3. REFERENCE MATERIALS USED TO EVALUATE THE RADIAN TEST PROGRAM

Material	Description
1. Fuel oil sample 1[a]	Fuel oil spiked with a known chloride concentration
2. Fuel oil sample 2	Similar to material No. 1
3. Fuel oil sample 3	Similar to material No. 1
4. Fuel oil sample 4	Similar to material No. 1
5. HCl impinger solution	HCl train impinger solution having verified chloride concentration
6. HCl impinger solution	Similar to material No. 5
7. Dioxin sample	2,3,7,8-TCDD in isooctane
8. Calibrated orifice	Used to evaluate the sampling trains' dry gas meter calibrations

[a] Fuel oil samples were not collected during the test program. (Auxiliary fuel oil was not burned at the plant.) However, during earlier tests where fuel oil samples were collected, audit data indicated that the fuel oil/chlorine analytical method used by a Radian subcontractor may have been inappropriate at chlorine concentrations below 1,000 ppm.[9] At Radian's request, the fuel oil samples listed in the above table were provided to examine the performance of the method selected to replace the original method.

3.0 AUDIT OBSERVATIONS

3.1 INTRODUCTION

RTI's observations for the Site BLB-B audit are discussed below. Since the sampling procedures used by Radian at this site were nearly identical to the procedures used during the previous audit, it is not necessary to repeat in this report the sampling checklists presented in the previous audit report. However, two new check lists are presented here which compare: (1) RTI's recommendations from the earlier audit with the procedures actually followed at Site BLB-B; and (2) RTI's comments on the Site BLB-B Test Plan with the procedures actually followed. These two checklists are presented in the Appendix.

3.2 PROCESS OPERATION

In contrast to the difficulties encountered with the Site ISW-A incinerator (i.e., variable loads and process disruptions), the Site BLB-B boiler operated smoothly during the audit. The plant's Director of Environmental Engineering reported that the boiler was at 100 percent capacity and that the feed composition was indicative of normal operation. The boiler's new electrostatic precipitator (ESP) was observed to discharge from the stack large dust flakes. However, this did not appear to interfere with post-ESP sampling.

The selection of an ESP-inlet sampling location was complicated by a split in the ductwork leading to two ESP chambers. Although Radian sampled only one of the two ductwork splits, it appeared that the gas composition in both splits would be identical.

3.3 MODIFIED METHOD 5 SAMPLING TRAIN

The MM5 sampling train appeared to be set up and operated according to the ASME MM5 sampling methodology specified in Radian's Test Plan, with two exceptions. First, the solvent used for recovery was changed from hexane to methylene chloride. This change in solvent was recommended by EPA as a result of the high blank values which occurred during earlier tests when hexane was used as the solvent.[10] The second exception to the ASME MM5 methodology involved the mounting of the XAD trap condenser in a horizontal position, as opposed to the vertical orientation specified in the ASME method. The horizontal mounting of the condenser was approved by EPA as a modification to the ASME MM5 methodology presented in Radian's Test Plan. (This approval was based on evidence that, for this test program, all condensed liquids are carried forward into the XAD resin regardless of whether the condenser is horizontally or vertically mounted.)

One sampling probe was broken during testing as a result of a torn cable during the vertical traversing at the inlet sampling location. Otherwise, all MM5 procedures specified in the test plan appeared to be implemented correctly.

3.4 BLANK MM5 AND HCl SAMPLING TRAINS

The blank MM5 sampling train was to be located on the roof of the building where the standard MM5 train was set up. (The blank train was not in use during the day of the audit.) It consisted of the essential elements of a standard MM5 train, except for the probe and meter box. The probe condenser inlet and the final impinger outlet were to be capped with hexane-rinsed aluminum foil, as required. The blank MM5 train was to remain assembled for the duration of one complete test run.

The blank HCl sampling train was also to be located on the roof of the building on which the standard MM5 train was set up. As with the blank MM5 train, the probe inlet and the final impinger outlet of the blank HCl train were capped with hexane-rinsed aluminum foil. The blank HCl train was to remain assembled for the duration of one complete test run.

3.5 AMBIENT MM5 SAMPLING TRAIN

An ambient MM5 sampling train was not used in this test program.

3.6 HCl SAMPLING TRAIN

No problems were reported or observed in the operation of the HCl train. (During the earlier audit, a broken probe occurred.)

3.7 CONTINUOUS EMISSION MONITORS

The continuous emission monitoring system consisted of a coarse filter, sampling probe, heated sampling line, moisture removal system, monitoring units, strip charts, and an excellent automated data acquisition system. Strip charts were carefully marked and all calibration data were recorded. Three-point calibrations were performed at the beginning of the test program, and two-point calibrations were performed at the beginning and end of each test run. Calibration and quality control gases were introduced at the beginning of the sample line near the stack for all gases except THC, which was introduced at the end of the sample line near the THC monitor. (Since THC is monitored on a wet basis, it is not necessary to pass either the stack gases or the calibration/QC gases through the gas conditioning system and sampling manifold.)

Strip charts were offset 10 percent to compensate for possible negative drifts. Monitor drift, in general, was negligible. Temperature variations within the continuous monitor trailer were minimized as a result of the air conditioning system.

3.8 PROCESS SAMPLES

The process sample collection activities involved the collection of representative samples of strong black liquor, white liquor, weak liquor, spent acids, byproduct salt cake, and well water. The test team collected two grab samples per test run of all samples, except for the strong black liquor which was collected hourly during each run. Process operating parameters were recorded hourly by hand. Additionally, the plant's printout of the operating parameters was retained in case any backup information was required.

3.9 SAMPLE HANDLING, TRANSPORTATION, AND STORAGE

Radian carefully packed samples to avoid possible breakage. The cleanliness of the analytical trailer and orderliness of equipment and supplies had been significantly improved since the first audit. Radian continued to mark sample weights rather than liquid levels on their sample bottles.

3.10 SOIL SAMPLING

The soil sampling activities were planned to be conducted as specified in the Test Plan. (The soil sampling was not performed on the day of the audit.) Site selection, proximity of samples, and sample compositing were recognized by Radian as being important aspects of the soil sampling program and were being studied at the time of the audit. The test team leader was considering sampling around the following locations: (1) area surrounding the ClO_2 systems; (2) area surrounding the evaporators; and (3) the perimeter of the plant. These samples would cover a wide area of grounds within, and surrounding, the plant, where potential dioxin contamination is most likely.

4.0 CONCLUSIONS

Overall, RTI was impressed with the Radian test team and the quality of their work. It appeared that the test team faithfully adhered to their Test Plan and QA Plan and that the required sampling procedures were carefully followed. Furthermore, most of RTI's earlier recommendation had been implemented. RTI is satisfied that the data generated by the test program will be of sufficient quality to achieve the objectives of the study, provided that: (1) the analytical procedures are performed correctly and (2) the sampling procedures continue to be performed with the same level of care exhibited during the Sites ISW-A and BLB-B tests.

5.0 REFERENCES

1. Richard V. Crume, Research Triangle Institute. "Quality Assurance Audit for TIER 4 of the National Dioxin Study: Industrial Incinerator Site ISW-A." Research Triangle Park, North Carolina. February 1985.

2. M. A. Palazzolo, Radian Corporation. "Site Specific Test Plan, Black Liquor Recovery Boiler, Test Number Four, Site BLB-B, National Dioxin Study, Tier 4: Combustion Sources." DCN No. 85-213-056-12-12. Research Triangle Park, North Carolina. February 1, 1985.

3. M. A. Palazzolo, R. F. Jongleux, L. E. Keller, and J. Bursey, Radian Corporation. "National Dioxin Study, Tier 4, Combustion Sources, Quality Assurance Project Plan." DCN No. 231-056-12-17. Research Triangle Park, North Carolina. March 5, 1985.

4. Radian Corporation. "Draft Report, National Dioxin Study, Tier 4, Combustion Sources, Sampling Procedures." DCN No. 84-240-016-51-09. Research Triangle Park, North Carolina. October 17, 1984.

5. U.S. Environmental Protection Agency. "Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans." QAMS-005/80. Washington, D.C. December 29, 1980.

6. Richard V. Crume, Research Triangle Institute. Review of Radian Corporation's Draft Report entitled "National Dioxin Study Tier 4: Combustion Sources Quality Assurance Project Plan." Research Triangle Park, North Carolina. October 23, 1984.

7. Richard V. Crume, Research Triangle Institute. Review of Radian Corporation's Revised Report entitled "National Dioxin Study Tier 4: Combustion Sources Quality Assurance Project Plan." Research Triangle Park, North Carolina. January 4, 1985.

8. Richard V. Crume, Research Triangle Institute. Letter to Mr. Bill Kuykendal, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency. Subject: Review of Radian Test Plan BLB-B. Research Triangle Park, North Carolina. February 20, 1985.

9. Richard V. Crume, Research Triangle Institute. Letter to Mr. Willam B. Kuykendal. Subject: Report of Analytical Results for the Audit Material of No. 2 Fuel Oil spiked with Chlorine. Research Triangle Park, North Carolina. February 4, 1985.

10. William B. Kuykendal, U.S. Environmental Protection Agency. Letter to Addressees. Subject: Change in Sample Recovery Reagents for Modified Method 5 Sampling on Tier 4 Sites. Research Triangle Park, North Carolina. February 27, 1985.

6.0 APPENDIX

6.1 AUDIT CHECKLISTS

Additional information concerning the Site BLB-B audit is presented in the following audit checklists.

6.1. CHECKLIST FOR RTI RECOMMENDATIONS FROM ISW-A AUDIT

Recommendation from ISW-A audit	Implemented at BLB-B site	Comments
1. Vertical XAD-condenser setup	No	Radian believes that the impinger box would be difficult to balance if a vertical condenser is used.
2. Blank MM5 train sealed throughout each test run	Yes	Capped with hexane-rinsed aluminum foil.
3. Calibration gases for the continuous monitors introduced through the entire sampling interface	Yes	All calibration gases were introduced through the entire sample line, except for the THC sample.
4. Temperature variations minimized in the continuous monitor trailer	Yes	Air conditioning system was working properly.
5. Stripcharts offset 10% to avoid negative drifts	Yes	
6. Soil sampling:		Soil sampling had not been conducted at the time of the audit. However, Radian reported that RTI's recommendations would be considered in designing the sampling scheme.
Representative sampling	N/A	
Sampling area properly cleaned prior to sampling	N/A	
7. General items:		
Process shutdown	N/A	The boiler operated continuously without significant load variations.
Stack exhaust fan interference	N/A	
Ambient air intake damper	N/A	
Operator cooperativeness	Yes	All plant personnel were extremely cooperative.

N/A = Not Applicable

6.2. CHECKLIST FOR RTI COMMENTS ON SITE BLB-B TEST PLAN

	Comment on test plan	Implemented during test	Explanation
1.	The collection of wood chip samples may be worthwhile, in case the chlorine content of the wood chips is ever questioned	N/A	The sampling of wood chips was not required by EPA during the Site BLB-B tests.
2.	Collection of ambient air samples	N/A	The collection of ambient air samples was not required by EPA during the Site BLB-B tests.
3.	Determination of black liquor heating value	No	This was not done. However, according to the plant's Environmental Manager, the feed composition during testing was representative of normal operation.
4.	Strong Black Liquor Sampling	Yes	The frequency of strong black liquor sampling (hourly) appeared to accommodate normal process variations.
5.	Vertical XAD condenser	No	The condenser was mounted in a horizontal position. Radian believes that the impinger box would be difficult to balance if a vertical condenser is used.
6.	Quality Control: HCl duplicates QC samples Well water blanks Flow rate audits Computer system evaluation QC gases	N/A	Some duplicates and blanks were to be used, including XAD blanks. However, flow rates were not to be checked. The computer system was assumed by Radian to produce valid data. QC gases were used, separate from calibration gases.
7.	Special safety precautions for handling the "hot" black liquor	Yes	Respirators were available for use during the collection of process samples. Care was taken to avoid contact with hot liquids.

N/A = Not Applicable

APPENDIX H

PROCESS MONITORING DATA

APPENDIX H-1

HOURLY AVERAGE VALUES OF BOILER OPERATING PARAMETERS

HOURLY PROCESS DATA FOR TEST RUN 1 - SITE 05

Run/Time	Black Liquor Solids Flow (1000 lb/hr)	Black Liquor Wt% Solids (Wt%)	Boiler Load (1000 lb/hr Steam)	Boiler Oxygen (% by vol.)	Black Liquor Temperature (°F)	ESP Temperature (°F) Ave. North&South	Primary Air (1000 lb/hr)	Secondary Air (1000 lb/hr)
10:00	122.2	69.0	338	2.66	257	329.8	27	35
11:00	121.4	68.9	346	3.26	260	327.6	29	34
12:00	121.4	68.9	347	2.94	260	329.7	29	34
13:00	122.6	69.4	344	2.70	260	330.1	29	34
14:01	123.1	69.5	347	3.52	260	333.9	29	36
15:00	124.1	69.4	339	2.71	259	334.5	27	35
16:01	124.8	70.0	329	2.06	259	328.4	27	35
17:01	126.4	71.6	335	2.70	259	326.5	27	35
18:01	126.2	71.3	340	3.69	260	333.1	27	35
19:00	125.3	70.5	364	2.89	259	333.2	27	35
20:00	124.3	70.6	359	2.39	259	332.7	27	35
21:00	125.1	70.6	351	1.92	259	328.1	27	35
22:00	125.4	70.6	363	1.81	259	323.6	28	35
23:00	125.0	70.6	358	1.62	260	326.0	27	36
0:00	124.9	70.6	352	1.73	259	653.1	27	36

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HOURLY PROCESS DATA FOR TEST RUN 2 - SITE 05

Run/Time	Black Liquor Solids Flow (1000 lb/hr)	Black Liquor Wt% Solids (Wt%)	Boiler Load (1000 lb/hr Steam)	Boiler Oxygen (% by vol.)	Black Liquor Temperature (°F)	ESP Temperature (°F) Ave. North&South	Primary Air (1000 lb/hr)	Secondary Air (1000 lb/hr)
09:00	126.1	70.4	335	1.94	259	324.8	27	36
10:00	125.0	69.7	333	1.89	260	327.6	27	35
11:00	125.0	69.7	329	1.80	260	328.5	27	35
12:00	124.0	69.2	327	1.55	260	329.8	27	36
13:00	123.9	69.2	338	1.66	259	330.4	27	37
14:00	126.1	70.6	348	2.05	259	328.5	27	37
15:00	126.5	71.0	341	1.56	260	327.1	27	35
16:00	125.0	70.7	331	1.76	260	326.7	27	36
17:00	125.7	70.6	335	1.89	260	327.3	27	35
18:01	126.1	70.7	336	1.88	259	327.2	28	35
19:00	126.9	71.1	342	1.69	260	325	27	35
20:01	124.8	70.8	335	1.71	260	326.5	28	36
21:00	124.5	70.2	329	1.45	260	326.5	27	36

HOURLY PROCESS DATA FOR TEST RUN 3 - SITE 05

Run/Time	Black Liquor Solids Flow (1000 lb/hr)	Black Liquor Wt% Solids (Wt%)	Boiler Load (1000 lb/hr Steam)	Boiler Oxygen (% by vol.)	Black Liquor Temperature (°F)	ESP Temperature (°F) Ave. North&South	Primary Air (1000 lb/hr)	Secondary Air (1000 lb/hr)
08:00	125.5	71.2	351	1.68	258	323.9	28	37
09:00	125.6	70.9	346	1.98	258	325.2	28	37
10:00	125.8	70.5	340	1.65	258	326.3	28	36
11:00	125.6	70.5	338	1.60	259	329	28	37
12:00	125.0	70.2	348	1.45	259	330.4	28	38
13:00	125.0	70.2	357	2.47	259	329.0	28	38
14:00	124.8	70	357	2.98	259	330.0	28	35
15:00	126.8	69.9	332	2.42	258	328.2	28	33
16:00	124.0	69.9	330	2.46	257	327.7	28	34
17:00	125.5	70.0	356	2.86	257	329.4	28	35
18:00	125.3	70.0	370	2.97	257	327.9	28	35
19:01	124.4	70.0	371	3.22	257	330.0	28	34
20:01	126.5	70.6	356	2.25	257	328.6	28	33

APPENDIX H-2

PLANT COMPUTER OUTPUT OF PROCESS DATA

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```
                              SYSTEM  DAILY STATUS REPORT
                               DATE: 2/28/85 TIME: 5: 1:11

SYSTEM UP

EMERGENCY SHUTDOWN : NONE

#4 BOILER  UP
#5 BOILER  UP
CONTROL PROGRAM STATUS : NORMAL
```

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```
BOILER #4 SH TC TEMPERATURE
           INTERMEDIATE FRONT
              LOOP A     LOOP D

   ROW  1      692        768
   ROW  2      692        816
   ROW  3      702        813
   ROW  4      721        796
   ROW  5      734        734
   ROW  6      740        834
   ROW  7      730        816
   ROW  8      731        817
   ROW  9      728        798
   ROW 10      709        826
   ROW 11      718        764
   ROW 12      734        824
   ROW 13      743        838
   ROW 14      762        782
   ROW 15      709        786
   ROW 16      753        728
   ROW 17      788        823
   ROW 18      776        793

CONSUMABLE=  -999.0 INTERM. AVG.=   731.7 FRONT  AVG.=   798.0
 STEAM TEMP=   834.5 DRUM PRESSURE=   145.0
```

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```
                          BOILER #5 SH TC TEMPERATURE
        SECONDARY          PRIMARY                          SECONDARY          PRIMARY
        LOOP B  LOOP A   LOOP B  LOOP A                   LOOP B  LOOP A   LOOP B  LOOP A

ROW  1   771      744      686     681   ROW 18            856     832      766     754
ROW  2   789      785      741     693   ROW 19            840     825      717     703
ROW  3   834      816      761     755   ROW 20            830     814      738     727
ROW  4   862      852     -999    -999   ROW 21            823     812      713     718
ROW  5   879      859     -999    -999   ROW 22            827     818      740     728
ROW  6   863      845      793     796   ROW 23            826     818      708     698
ROW  7   804      863      758     763   ROW 24            845     835      733     717
ROW  8   860      848      790     745   ROW 25            848     847      705     702
ROW  9   837      817      741     735   ROW 26           -999     837      731     711
ROW 10   849      838      753     776   ROW 27            816     823      699     692
ROW 11   843      813      743     738   ROW 28            822     831      698     704
ROW 12   848      831      779     752   ROW 29            812     815      700     688
ROW 13   829      830      726     726   ROW 30            808     815      709     685
ROW 14   828      824      760     746   ROW 31            803     796      682     678
ROW 15   851      829      729     703   ROW 32            806     800      694     689
ROW 16   837      833      761     722   ROW 33            799     792      672     654
ROW 17   848      827      722     698   ROW 34            773     775      652     634

OUTLET TEMP   821. PRESS  1048. CONSUMABL    77. SEC AVG  829. PRI AVG  724.
```

24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE 2/20/85 TIME 6:10 DATA DATE 2/20/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 C

	PERFORMANCE	GREEN LIQUOR			STEAM				FLUE GAS		
TIME (HR:MIN)	LB STEAM/ LB BLS	NORTH A TEST (LB NA2O/ GAL.)	SULFIDITY (%)	SOUTH A TEST (LB NA2O/ GAL.)	STEAM TEMP (DEGF)	STEAM FLOW (MPPH)	SOOTBLOWING STEAM (MPPH)	FEEDWATER FLOW (MPPH)	PER CENT OXYGEN (%)	CONSUMED AIR (MPPH)	CARBON MONOXIDE (PPM)
7:00	2.822	9.6	23.7	9.8	821.	354.	13.4	366.	1.79	622.34	987.82
8:00	2.794	9.8	23.9	9.7	825.	351.	13.2	360.	1.68	624.59	989.09
9:00	2.753	10.3	24.2	9.7	822.	346.	12.9	355.	1.98	612.34	994.16
10:00	2.701	10.4	24.2	9.8	827.	340.	13.1	353.	1.65	617.84	994.89
11:00	2.690	10.4	24.2	9.8	824.	338.	12.8	353.	1.60	627.40	980.20
12:00	2.777	10.1	24.2	10.1	824.	348.	14.2	359.	1.45	645.78	962.18
13:00	2.852	10.1	24.2	10.1	825.	357.	12.9	369.	2.47	594.82	779.36
14:00	2.859	10.2	24.2	10.1	824.	357.	13.2	362.	2.98	546.13	870.03
SHIFT AVG.	2.781	10.1	24.1	9.9	824.	349.	13.2	360.	1.95	611.41	944.72
SHIFT TOTAL(M-LBS)						2790.	105.6	2877.			
15:00	2.618	10.2	24.2	10.1	823.	332.	12.9	348.	2.42	541.34	989.01
16:00	2.659	10.2	23.5	9.9	826.	330.	13.1	347.	2.48	559.95	981.82
17:00	2.834	10.3	22.7	9.7	826.	356.	13.6	362.	2.86	549.51	988.62
18:00	2.946	10.4	22.7	9.9	827.	370.	13.6	364.	2.97	547.77	991.08
19:01	2.980	10.4	22.7	10.0	826.	371.	12.6	367.	3.22	534.17	999.90
20:01	2.813	10.0	22.7	9.9	824.	356.	13.5	347.	2.25	562.58	1000.00
21:00	2.756	9.9	22.7	9.8	832.	350.	13.3	345.	2.49	556.89	1000.00
22:01	2.850	9.9	22.7	9.8	827.	362.	13.5	355.	3.08	536.62	1000.00
SHIFT AVG.	2.807	10.2	23.0	9.9	826.	353.	13.3	354.	2.72	548.60	993.80
SHIFT TOTAL(M-LBS)						2827.	106.2	2834.			
23:01	2.897	9.9	22.7	9.9	824.	368.	13.4	363.	2.33	562.34	1000.00
0:01	2.707	10.2	23.4	10.2	828.	351.	13.3	347.	2.40	551.47	1000.00
1:01	2.761	10.3	23.6	10.2	828.	343.	13.3	341.	2.53	545.28	988.29
2:01	2.844	10.3	23.6	10.0	827.	346.	13.3	348.	2.84	533.71	988.67
3:00	2.842	10.1	23.6	10.0	830.	344.	12.6	339.	2.08	561.75	988.72
4:01	2.797	10.0	23.6	10.0	826.	338.	13.5	334.	1.79	574.97	987.59
5:00	2.802	10.1	23.6	10.0	830.	342.	14.0	344.	2.44	549.69	987.99
6:00	2.858	10.1	23.6	10.0	835.	350.	12.3	354.	3.20	522.91	994.22
SHIFT AVG.	2.823	10.1	23.5	10.0	829.	348.	13.2	346.	2.45	550.26	991.93
SHIFT TOTAL(M-LBS)						2781.	105.6	2770.			
DAILY AVG.	2.804	10.1	23.5	9.9	826.	350.	13.2	353.	2.37	570.09	976.82
DAILY TOTAL(M-LBS)						8398.	317.4	8481.			

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                        24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

  DATE  2/28/85  TIME  6:13  DATA DATE  2/28/85
  SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 C

                              AIR PRESSURES                       AIR FLOWS

    TIME    FD OUTLET  MAIN DUCT PRIMARY  SECONDARY  PRIMARY     TOTAL    ID FAN       AIR
                                  DUCT      DUCT       AIR        AIR      SPEED      HEATER
  (HR:MIN)  (IN H2O)   (IN H2O) (IN H2O)  (IN H2O)   (MPPH)     (MPPH)    (RPM)      (DEGF)
     7:00    -999.0       5.1      0.1       5.8       28.        66.       310.       263.
     8:00    -999.0       4.6      0.6       5.6       28.        65.       309.       264.
     9:00    -999.0       3.8      0.4       5.3       28.        65.       315.       259.
    10:00    -999.0       3.0      0.4       5.0       28.        64.       320.       258.
    11:00    -999.0       2.7      0.2       4.9       28.        65.       330.       260.
    12:00    -999.0       2.4      0.6       4.8       28.        66.       321.       260.
    13:00    -999.0       2.2      0.4       4.7       28.        66.       313.       260.
    14:00    -999.0       2.3      0.1       4.8       28.        63.       309.       262.

  SHIFT AVG.-999.0        3.3      0.3       5.1       28.        65.       316.       261.

  SHIFT TOTAL(M-LBS)                                   223.       521.

    15:00    -999.0       2.4      0.2       4.9       28.        61.       311.       261.
    16:00    -999.0       2.2      0.9       4.8       28.        62.       306.       261.
    17:00    -999.0       2.1      0.2       4.8       28.        62.       311.       262.
    18:00    -999.0       2.1      0.1       4.8       28.        63.       312.       258.
    19:01    -999.0       2.1      0.3       5.0       28.        62.       317.       259.
    20:01    -999.0       1.8      0.6       5.1       28.        61.       312.       262.
    21:00    -999.0       1.6      0.6       5.4       28.        62.       319.       262.
    22:01    -999.0       1.5      0.1       5.7       28.        62.       320.       262.

  SHIFT AVG.-999.0        2.0      0.4       5.0       28.        62.       314.       261.

  SHIFT TOTAL(M-LBS)                                   222.       495.

    23:01    -999.0       1.7      0.1       5.8       28.        61.       305.       263.
     0:01    -999.0       1.8      0.7       6.1       28.        61.       297.       265.
     1:01    -999.0       1.8      0.8       6.2       28.        60.       299.       267.
     2:01    -999.0       1.5      0.3       6.2       28.        60.       307.       269.
     3:00    -999.0       1.9      0.8       6.5       28.        60.       299.       268.
     4:01    -999.0       2.0      1.1       6.7       28.        60.       296.       271.
     5:00    -999.0       2.1      0.4       6.8       28.        61.       294.       271.
     6:00    -999.0       2.0      0.1       6.8       28.        61.       300.       271.

  SHIFT AVG.-999.0        1.8      0.5       6.4       28.        61.       298.       268.

  SHIFT TOTAL(M-LBS)                                   225.       485.

  DAILY AVG.-999.0        2.4      0.4       5.5       28.        62.       310.       263.

  DAILY TOTAL(M-LBS)                                   670.      1500.
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24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE 2/28/85 TIME 6:15 DATA DATE 2/28/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 C

	AIR TEMPERATURES				FLAKT PRECIP.				
TIME (HR:MIN)	ECON INLET (DEGF)	ECON OUTLET (DEGF)	UPPER CASCADE (DEGF)	LOWER CASCADE (DEGF)	NORTH INLET (DEGF)	NORTH OUTLET (DEGF)	SOUTH INLET (DEGF)	SOUTH OUTLET (DEGF)	ID FAN INLET (DEGF)
7:00	853.5	616.1	411.0	393.1	341.1	326.3	344.5	328.2	306.4
8:00	866.3	612.8	414.4	392.3	337.9	322.0	343.3	325.7	302.9
9:00	870.1	629.0	417.8	395.2	338.9	321.7	347.8	328.6	305.6
10:00	877.7	643.5	417.3	397.0	340.6	322.9	348.4	329.6	307.1
11:00	885.1	663.6	417.7	401.1	344.8	325.3	350.5	332.7	310.8
12:00	868.8	663.6	413.6	401.3	345.7	327.3	350.8	333.5	312.6
13:00	849.4	633.5	407.7	395.4	345.1	327.1	346.1	330.9	312.3
14:00	854.6	628.4	411.4	396.1	347.6	329.4	346.3	330.5	313.6
SHIFT AVG.	865.7	636.3	413.9	396.4	342.7	325.2	347.2	330.0	308.9
15:00	852.7	630.6	409.8	394.3	341.9	326.3	346.6	330.1	312.1
16:00	842.6	632.0	409.0	392.4	343.2	325.3	344.6	330.0	312.3
17:00	852.4	630.3	410.2	394.9	343.2	327.3	347.6	331.4	314.9
18:00	849.4	619.6	405.5	391.1	343.5	326.7	345.7	329.1	313.3
19:01	852.0	630.5	418.5	396.1	345.9	328.5	349.1	331.4	314.3
20:01	843.7	633.0	415.5	394.9	343.5	326.9	346.7	330.3	312.3
21:00	863.5	647.3	418.9	397.1	352.2	331.0	351.8	332.4	315.0
22:01	870.2	658.2	419.9	395.9	355.1	334.7	352.4	334.2	317.5
SHIFT AVG.	853.3	635.2	413.4	394.6	346.1	328.4	348.1	331.1	314.0
23:01	853.1	642.2	412.0	393.1	348.2	332.0	346.6	331.1	314.9
0:01	843.9	613.6	406.5	385.2	339.2	325.2	341.6	325.2	308.9
1:01	851.3	613.9	411.9	385.1	339.3	321.9	345.2	327.1	308.3
2:01	852.7	618.3	408.8	387.8	344.1	325.7	346.2	329.0	311.9
3:00	861.9	617.6	408.1	387.2	339.8	324.1	343.4	327.2	309.9
4:01	854.7	608.5	403.6	384.1	338.1	321.5	341.1	324.7	306.5
5:00	832.1	595.8	399.1	379.8	340.9	321.6	338.9	322.3	305.1
6:00	855.1	601.9	400.6	381.6	344.9	325.2	344.2	324.6	307.2
SHIFT AVG.	850.6	614.0	406.3	385.5	341.8	324.7	343.4	326.4	309.1
DAILY AVG.	856.5	628.5	411.2	392.2	343.5	326.1	346.2	329.2	310.7

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24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE 2/28/85 TIME 6:10 DATA DATE 2/28/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 C

FURNACE DRAFTS

TIME (HR:MIN)	FURNACE DRAFT (IN H2O)	SH INTER. DRAFT (IN H2O)	BOILER IN DRAFT (IN H2O)	BOILER INT DRAFT (IN H2O)	BOILER OUT DRAFT (IN H2O)	ECON OUT DRAFT (IN H2O)	UPPER CAS OUTLET (IN H2O)	LOWER CASCADE OUTLET (IN H2O)
7:00	-0.5	-0.6	-0.6	-0.6	6.2	-2.0	-4.0	-3.9
8:00	-0.5	-0.8	-0.6	-1.0	6.2	-2.0	-4.0	-4.0
9:00	-0.5	-0.7	-0.6	-1.7	6.2	-2.1	-4.1	-4.0
10:00	-0.6	-0.4	-0.6	-1.9	6.2	-2.3	-4.3	-4.2
11:00	-0.5	2.1	-0.6	-0.5	6.2	-2.4	-4.5	-4.4
12:00	-0.6	3.7	-0.6	0.5	6.2	-2.2	-4.2	-4.1
13:00	-0.6	2.8	-0.6	-0.3	6.2	-2.1	-4.0	-3.9
14:00	-0.6	1.2	-0.6	-1.1	6.2	-2.1	-4.0	-4.0
SHIFT AVG.	-0.6	0.9	-0.6	-0.8	6.2	-2.2	-4.1	-4.1
15:00	-0.6	-0.2	-0.6	-1.7	6.2	-2.1	-3.9	-3.9
16:00	-0.6	-0.6	-0.6	-1.8	6.2	-2.1	-3.9	-3.8
17:00	-0.6	-0.7	-0.6	-2.0	6.2	-2.1	-3.9	-3.9
18:00	-0.6	-0.7	-0.6	-2.0	6.2	-2.1	-3.9	-3.9
19:01	-0.5	-0.6	-0.6	-1.9	6.2	-2.2	-4.1	-4.0
20:01	-0.5	-0.5	-0.6	-1.8	6.2	-2.2	-4.0	-4.0
21:00	-0.6	-0.5	-0.6	-1.9	6.2	-2.3	-4.2	-4.2
22:01	-0.6	-0.4	-0.6	-1.8	6.2	-2.3	-4.2	-4.2
SHIFT AVG.	-0.6	-0.5	-0.6	-1.9	6.2	-2.2	-4.0	-4.0
23:01	-0.5	0.2	-0.6	-1.5	6.2	-2.0	-3.9	-3.8
0:01	-0.5	0.4	-0.6	-1.4	6.2	-2.0	-3.7	-3.7
1:01	-0.5	0.8	-0.6	-1.3	6.2	-2.0	-3.7	-3.7
2:01	-0.6	0.6	-0.6	-1.4	6.2	-2.2	-3.9	-3.9
3:00	-0.5	1.0	-0.6	-1.1	6.2	-2.0	-3.7	-3.7
4:01	-0.5	1.3	-0.6	-1.0	6.2	-2.0	-3.7	-3.6
5:00	-0.5	1.9	-0.6	-0.6	6.2	-1.9	-3.6	-3.6
6:00	-0.5	2.1	-0.6	-0.5	6.2	-2.1	-3.7	-3.7
SHIFT AVG.	-0.5	1.0	-0.6	-1.1	6.2	-2.0	-3.7	-3.7
DAILY AVG.	-0.6	0.5	-0.6	-1.3	6.2	-2.1	-4.0	-3.9

24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE 2/28/85 TIME 6:20 DATA DATE 2/28/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 C

					BLACK LIQUOR						
TIME (HR:MIN)	BL PRESSURE (PSI)	PRIM BL HEATER TEMP (DEGF)	SEC BL HEATER TEMP (DEGF)	BL FLOW (GPM)	LBS SOLIDS BURNED (MPPH)	NO. SPRAYS	METER AVG. %BLS	TESTER % BLS	UPPER MOTOR LOAD (%)	LOWER MOTOR LOAD (%)	CHEM ASH TK BL PRESSURE (PSI)
7:00	24.	226.	258.	254.	125.4	7.	69.5	71.3	38.2	37.6	42.
8:00	25.	226.	258.	255.	125.5	7.	69.7	71.2	39.6	39.5	41.
9:00	25.	226.	258.	256.	125.6	7.	69.5	70.9	39.6	37.6	40.
10:00	26.	226.	258.	259.	125.8	7.	69.7	70.5	38.9	37.9	40.
11:00	24.	226.	259.	258.	125.6	7.	69.5	70.5	38.8	38.0	40.
12:00	24.	226.	259.	258.	125.0	7.	69.0	70.2	38.0	37.1	40.
13:00	23.	224.	259.	258.	125.0	7.	68.2	70.2	37.5	36.4	40.
14:00	24.	224.	259.	260.	124.8	7.	68.3	70.0	37.3	36.4	40.
SHIFT AVG.	24.	225.	258.	257.	125.3	7.	69.2	70.6	38.5	37.6	41.
SHIFT TOTAL				123493. GAL1002.7 M-LBS							
15:00	25.	224.	258.	259.	126.8	7.	68.4	69.9	37.6	36.7	41.
16:00	24.	224.	257.	258.	124.0	7.	68.5	69.9	37.6	36.5	41.
17:00	25.	224.	257.	260.	125.5	7.	68.6	70.0	37.7	35.9	41.
18:00	25.	224.	257.	260.	125.3	7.	68.5	70.0	38.0	36.3	41.
19:01	24.	225.	257.	258.	124.4	7.	68.5	70.0	38.1	36.2	41.
20:01	24.	225.	257.	260.	126.5	7.	68.8	70.6	38.1	36.5	41.
21:00	24.	225.	257.	260.	126.9	7.	68.5	70.8	37.8	36.0	41.
22:01	24.	226.	257.	259.	127.0	7.	68.7	70.8	37.9	36.6	41.
SHIFT AVG.	24.	225.	258.	259.	125.8	7.	68.6	70.3	37.9	36.3	41.
SHIFT TOTAL				124457. GAL1006.3 M-LBS							
24:01	24.	225.	257.	260.	126.9	7.	68.6	70.7	38.0	36.1	41.
0:01	24.	222.	257.	260.	125.9	7.	67.9	70.2	37.7	36.0	41.
1:01	24.	221.	257.	260.	123.9	7.	67.9	69.4	37.1	36.4	41.
2:01	23.	222.	257.	260.	121.6	7.	67.5	68.5	36.5	36.2	41.
3:00	25.	223.	257.	259.	121.1	7.	68.0	68.3	37.0	36.1	41.
4:01	25.	222.	257.	260.	120.7	7.	68.0	68.1	36.8	35.3	41.
5:00	25.	221.	257.	260.	121.9	7.	67.6	68.7	36.9	34.8	41.
6:00	25.	220.	257.	260.	122.5	7.	67.2	68.9	36.5	35.0	41.
SHIFT AVG.	24.	222.	257.	260.	123.1	7.	67.8	69.1	37.0	35.7	41.
SHIFT TOTAL				124638. GAL.984.6 M-LBS							
DAILY AVG.	24.	224.	258.	259.	124.7	7.	68.5	70.0	37.8	36.5	41.
DAILY TOTAL				372588. GAL2993.5 M-LBS							

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                         24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

 DATE  2/20/85  TIME  6:23  DATA DATE  2/28/85
 SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 C

                        FUEL OIL                             TANK LEVELS

   TIME        OIL        OIL     FUEL OIL    50% BL  PRECIPITATOR DUMP      NORTH      SOUTH
            PRESSURE      TEMP     BURNED    STORAGE      LEVEL     TANK   DISSOLVER DISSOLVER
 (HR:MIN)     (PSI)      (DEGF)    (MPPH)      (FT)     (INCHES)    (FT)      (FT)       (FT)

    7:00       63.        158.       0.0     -999.0     -999.0      3.8       0.8        2.9
    8:00       60.        158.       0.0     -999.0     -999.0      3.9       0.7        2.9
    9:00       58.        158.       0.0     -999.0     -999.0      4.0       1.1        2.9
   10:00       55.        156.       0.0     -999.0     -999.0      4.0       1.3        2.9
   11:00       52.        154.       0.0     -999.0     -999.0      4.1       1.3        2.8
   12:00       51.        153.       0.0     -999.0     -999.0      4.3       1.2        2.8
   13:00       49.        154.       0.0     -999.0     -999.0      4.2       1.2        2.8
   14:00       57.        193.       0.0     -999.0     -999.0      4.3       1.1        2.9

 SHIFT AVG.    56.        161.       0.0     -999.0     -999.0      4.1       1.1        2.8

 SHIFT TOTAL(M-LBS)                  0.0

   15:00       59.        198.       0.0     -999.0     -999.0      4.1       1.3        2.8
   16:00       58.        194.       0.0     -999.0     -999.0      4.3       1.3        2.8
   17:00       57.        194.       0.0     -999.0     -999.0      4.2       1.2        2.8
   18:00       55.        195.       0.0     -999.0     -999.0      4.1       1.3        2.8
   19:01       54.        196.       0.0     -999.0     -999.0      3.8       1.3        2.8
   20:01       53.        197.       0.0     -999.0     -999.0      3.9       1.2        2.7
   21:00       53.        197.       0.0     -999.0     -999.0      4.0       1.3        2.6
   22:01       52.        198.       0.0     -999.0     -999.0      4.2       1.2        2.6

 SHIFT AVG.    55.        196.       0.0     -999.0     -999.0      4.1       1.3        2.7

 SHIFT TOTAL(M-LBS)                  0.0

   23:01       53.        199.       0.0     -999.0     -999.0      4.3       1.2        2.6
    0:01       53.        200.       0.0     -999.0     -999.0      4.1       1.2        2.5
    1:01       58.        220.       0.0     -999.0     -999.0      4.1       1.1        2.5
    2:01       60.        224.       0.0     -999.0     -999.0      4.1       1.2        2.6
    3:00       60.        224.       0.0     -999.0     -999.0      4.3       1.2        2.5
    4:01       58.        225.       0.0     -999.0     -999.0      4.4       1.2        2.6
    5:00       52.        214.       0.0     -999.0     -999.0      4.5       1.2        2.6
    6:00       52.        210.       0.0     -999.0     -999.0      4.6       1.2        2.6

 SHIFT AVG.    56.        215.       0.0     -999.0     -999.0      4.3       1.2        2.5

 SHIFT TOTAL(M-LBS)                  0.0

 DAILY AVG.    55.        190.       0.0     -999.0     -999.0      4.2       1.2        2.7

 DAILY TOTAL(M-LBS)                  0.0
```

```
2/28/85            RECOVERY ON CONTROL SUMMARY

                             NO.4                                 NO.5
                             (%)                                  (%)

 * BY SHIFT *       7-3 B    3-11 A    11-7 C       7-3 B    3-11 A    11-7 C

 CONSUMED AIR       95.9     41.5      0.0          56.3     100.0     98.0
 OPTIMUM O2         68.8     41.5      0.0          56.3     83.8      98.0
  TARGET THRUPUT    68.8     39.3      0.0          0.0      0.0       0.0

  *** TOTAL ***              NO.4                            NO.5 .

 CONSUMED AIR                45.8 %                          84.8 %
 OPTIMUM O2                  36.8 %                          82.7 %
  TARGET THRUPUT             36.0 %                           0.0 %


                         RECOVERY UTILIZATION

                             NO.4                            NO.5

 * BY SHIFT *       7-3 B    3-11 A    11-7 C      7-3 B     3-11 A    11-7 C

 TIME OFF LIQUOR    0.0 HRS  0.0 HRS   0.0 HRS     0.0 HRS   0.0 HRS   0.0 HRS

 % OF MAX LOAD      116.6 %  116.9 %   114.2 %     109.7 %   111.5 %   108.9 %


  *** TOTAL ***              NO.4                            NO.5

 TIME OFF LIQUOR             0.0 HRS                         0.0 HRS

 % OF MAX LOAD               115.9 %                         110.0 %
```

```
TIME  7:30                            PULP & PAPER CO.
                            RECOVERY BOILER PERFORMANCE REPORT
                                       FOR  2/28/85

                            #4 RECOVERY BOILER             #5 RECOVERY BOILER
                             AVG.         TOTAL             AVG.          TOTAL

BLACK LIQUOR FLOW           259.0 GAL    372932. GAL       358.8 GAL     516687. GAL
% BLACK LIQ. SOLIDS          69.9 %                         67.2 %

TOTAL SOLIDS BURNED         124.6 MLBS    2.991 MMLBS      164.8 MLBS     3.956 MMLBS
TOTAL SOLIDS TARGET         112.5 MLBS    2.701 MMLBS      162.5 MLBS     3.900 MMLBS
% OF TARGET BURNED                        110.7 %                         101.4 %

STEAM PRODUCED              367.5 MLBS   8821. MLBS        539.8 MLBS    12955. MLBS
LB. STEAM / LB. BLS          2.804                          3.274
```

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```
                              SYSTEM  DAILY STATUS REPORT
                               DATE: 2/27/85 TIME: 5: 6:11

SYSTEM UP

EMERGENCY SHUTDOWN : NONE

#4 BOILER  UP
#5 BOILER  UP
CONTROL PROGRAM STATUS : NORMAL
```

```
BOILER #4 SH TC TEMPERATURE
          INTERMEDIATE FRONT
             LOOP A    LOOP D

  ROW  1      709       773
  ROW  2      709       826
  ROW  3      723       822
  ROW  4      738       803
  ROW  5      756       737
  ROW  6      762       844
  ROW  7      752       821
  ROW  8      750       819
  ROW  9      747       798
  ROW 10      730       828
  ROW 11      730       768
  ROW 12      758       824
  ROW 13      769       844
  ROW 14      786       786
  ROW 15      724       789
  ROW 16      775       730
  ROW 17      819       835
  ROW 18      795       800

CONSUMABLE=  -999.0 INTERM. AVG.=   752.2 FRONT  AVG.=   803.1
 STEAM TEMP=   820.9 DRUM PRESSURE=   145.0
```

```
                          BOILER #5 SH TC TEMPERATURE
       SECONDARY          PRIMARY                         SECONDARY          PRIMARY
       LOOP B  LOOP A   LOOP B  LOOP A                   LOOP B  LOOP A   LOOP B  LOOP A

ROW  1  769      757      685      675   ROW 18         858      837      780      766
ROW  2  787      786      731      688   ROW 19         841      831      721      715
ROW  3  827      811      743      738   ROW 20         835      825      758      743
ROW  4  848      838     -999     -999   ROW 21         828      816      731      737
ROW  5  857      844     -999     -999   ROW 22         834      825      765      750
ROW  6  847      830      761      765   ROW 23         838      830      733      720
ROW  7  867      865      736      737   ROW 24         865      847      775      756
ROW  8  846      838      761      723   ROW 25         862      863      740      743
ROW  9  828      808      721      713   ROW 26        -999      859      778      754
ROW 10  838      827      737      755   ROW 27         834      842      736      716
ROW 11  825      811      734      725   ROW 28         841      850      729      742
ROW 12  843      825      766      744   ROW 29         830      834      732      719
ROW 13  825      827      717      722   ROW 30         825      828      731      709
ROW 14  817      823      758      742   ROW 31         814      806      705      700
ROW 15  852      831      726      705   ROW 32         817      810      709      707
ROW 16  839      833      764      726   ROW 33         809      801      682      667
ROW 17  851      830      727      703   ROW 34         778      786      662      641

OUTLET TEMP   820. PRESS  1055. CONSUMABL     72. SEC AVG  828. PRI AVG  720.
```

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24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE 2/27/85 TIME 6:10 DATA DATE 2/27/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 C

	PERFORMANCE	GREEN LIQUOR			STEAM				FLUE GAS		
TIME (HR:MIN)	LB STEAM/ LB BLS	NORTH A TEST (LB NA2O/ GAL.)	SULFIDITY (%)	SOUTH A TEST (LB NA2O/ GAL.)	STEAM TEMP (DEGF)	STEAM FLOW (MPPH)	SOOTBLOWING STEAM (MPPH)	FEEDWATER FLOW (MPPH)	PER CENT OXYGEN (%)	CONSUMED AIR (MPPH)	CARBON MONOXIDE (PPM)
7:00	2.604	9.8	22.2	9.9	828.	326.	13.8	342.	1.46	616.93	998.63
8:00	2.685	9.9	22.7	9.7	824.	336.	12.8	353.	1.97	605.46	991.91
9:00	2.650	10.2	24.0	9.2	826.	335.	13.3	351.	1.94	590.08	991.87
10:00	2.659	10.3	24.0	9.6	821.	333.	13.0	348.	1.89	585.94	991.51
11:00	2.627	10.3	24.0	9.6	828.	329.	12.8	342.	1.80	592.93	990.69
12:00	2.638	10.0	24.0	9.9	826.	327.	12.3	341.	1.55	606.73	985.02
13:00	2.727	10.0	24.0	9.9	823.	338.	14.0	353.	1.66	609.05	962.93
14:00	2.753	9.8	24.0	9.7	825.	348.	12.8	360.	2.05	596.24	963.85
SHIFT AVG.	2.668	10.0	23.6	9.7	825.	334.	13.1	349.	1.79	600.42	984.55
SHIFT TOTAL(M-LBS)						2672.	104.8	2780.			
15:00	2.693	9.7	24.0	9.7	824.	341.	13.1	348.	1.56	602.48	983.67
16:00	2.646	9.8	23.5	10.0	824.	331.	13.0	347.	1.76	597.56	982.24
17:00	2.663	9.8	23.3	10.2	824.	335.	13.1	349.	1.89	587.99	989.87
18:01	2.661	9.9	23.3	10.1	824.	336.	13.4	354.	1.88	590.90	990.71
19:00	2.693	10.1	23.3	9.9	825.	342.	13.3	350.	1.69	596.11	996.58
20:01	2.680	10.0	23.3	9.8	823.	335.	12.7	348.	1.71	607.90	994.43
21:00	2.640	9.9	23.3	9.5	822.	329.	11.2	338.	1.45	613.63	999.35
22:01	2.673	9.9	23.3	9.5	829.	332.	13.5	347.	1.78	618.95	992.58
SHIFT AVG.	2.669	9.9	23.4	9.8	825.	335.	12.9	348.	1.71	601.94	991.18
SHIFT TOTAL(M-LBS)						2680.	103.3	2781.			
23:00	2.797	9.9	23.3	9.5	824.	347.	12.6	359.	1.60	628.56	990.26
0:00	2.854	9.9	23.6	9.1	823.	354.	13.6	357.	1.64	631.36	995.33
1:00	2.857	9.9	23.7	9.0	824.	354.	13.5	366.	1.77	631.22	986.65
2:00	2.853	9.8	23.7	9.0	824.	353.	13.3	361.	1.67	628.68	986.75
3:00	2.796	9.8	23.7	9.2	825.	345.	13.1	356.	1.58	635.86	988.07
4:00	2.854	9.8	23.7	9.5	823.	353.	13.4	364.	1.65	642.44	987.31
5:00	2.899	9.7	23.7	9.7	824.	359.	11.2	360.	1.68	633.34	988.49
6:00	2.849	9.6	23.7	9.8	824.	356.	13.6	361.	1.83	629.54	986.40
SHIFT AVG.	2.845	9.8	23.6	9.3	824.	353.	13.0	360.	1.68	632.63	988.66
SHIFT TOTAL(M-LBS)						2821.	104.3	2883.			
DAILY AVG.	2.727	9.9	23.6	9.6	825.	341.	13.0	352.	1.73	611.66	988.13
DAILY TOTAL(M-LBS)						8172.	312.5	8454.			

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                    24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE  2/27/85  TIME  6:13  DATA DATE  2/27/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 C

                    AIR PRESSURES                       AIR FLOWS

  TIME     FD OUTLET  MAIN DUCT PRIMARY  SECONDARY  PRIMARY    TOTAL    ID FAN     AIR
                                DUCT      DUCT       AIR        AIR     SPEED    HEATER
 (HR:MIN)  (IN H2O)   (IN H2O) (IN H2O)  (IN H2O)   (MPPH)     (MPPH)   (RPM)    (DEGF)
   7:00    -999.0       8.9      0.3       7.2       27.        64.      304.     262.
   8:00    -999.0       8.6      0.9       7.1       27.        64.      299.     258.
   9:00    -999.0       8.3      0.4       7.0       27.        63.      301.     258.
  10:00    -999.0       7.9      0.8       6.9       27.        62.      304.     258.
  11:00    -999.0       8.1      0.5       6.9       27.        62.      311.     259.
  12:00    -999.0       7.8      0.7       6.8       27.        63.      318.     257.
  13:00    -999.0       8.0      0.5       6.9       27.        64.      317.     258.
  14:00    -999.0       8.5      0.6       7.1       27.        64.      306.     257.

SHIFT AVG.-999.0        8.3      0.6       7.0       27.        63.      307.     258.

SHIFT TOTAL(M-LBS)                                   218.       505.

  15:00    -999.0       8.8      0.6       7.3       27.        62.      302.     259.
  16:00    -999.0       8.9      1.2       7.3       27.        63.      306.     260.
  17:00    -999.0       8.6      0.4       7.2       27.        62.      310.     261.
  18:01    -999.0       8.5      0.6       7.1       28.        63.      304.     261.
  19:00    -999.0       8.3      0.9       7.0       27.        62.      300.     260.
  20:01    -999.0       8.0      1.1       6.9       28.        64.      301.     261.
  21:00    -999.0       7.7      0.9       6.7       27.        63.      303.     261.
  22:01    -999.0       7.3      0.5       6.6       28.        65.      322.     259.

SHIFT AVG.-999.0        8.3      0.8       7.0       27.        63.      306.     260.

SHIFT TOTAL(M-LBS)                                   219.       504.

  23:00    -999.0       7.0      0.5       6.5       28.        65.      325.     258.
   0:00    -999.0       6.8      0.7       6.4       28.        66.      316.     257.
   1:00    -999.0       6.5      0.2       6.3       28.        66.      311.     257.
   2:00    -999.0       6.1      0.5       6.1       28.        66.      307.     258.
   3:00    -999.0       6.0      0.4       6.1       28.        66.      317.     259.
   4:00    -999.0       6.1      0.4       6.1       28.        67.      325.     259.
   5:00    -999.0       6.1      0.6       6.2       28.        66.      310.     260.
   6:00    -999.0       5.7      0.5       6.0       27.        66.      312.     262.

SHIFT AVG.-999.0        6.3      0.5       6.2       28.        66.      315.     259.

SHIFT TOTAL(M-LBS)                                   223.       529.


DAILY AVG.-999.0        7.6      0.6       6.7       27.        64.      310.     259.

DAILY TOTAL(M LBS)                                   660.      1538.
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24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE 2/27/85 TIME 6:15 DATA DATE 2/27/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 C

	AIR TEMPERATURES				FLAKT PRECIP.				
TIME (HR:MIN)	ECON INLET (DEGF)	ECON OUTLET (DEGF)	UPPER CASCADE (DEGF)	LOWER CASCADE (DEGF)	NORTH INLET (DEGF)	NORTH OUTLET (DEGF)	SOUTH INLET (DEGF)	SOUTH OUTLET (DEGF)	ID FAN INLET (DEGF)
7:00	849.1	634.5	379.7	376.6	348.0	328.3	348.2	328.6	305.0
8:00	827.5	615.0	373.8	373.5	344.3	326.3	342.5	326.1	303.2
9:00	826.6	607.0	373.8	370.9	345.6	325.2	343.0	324.3	301.9
10:00	841.6	621.7	380.7	372.7	347.4	328.0	345.9	327.2	305.5
11:00	844.7	634.1	380.5	374.7	347.6	328.8	348.2	328.1	306.7
12:00	861.5	652.8	378.3	378.3	346.5	328.3	351.1	331.2	307.8
13:00	849.0	650.6	376.6	378.3	348.9	329.5	349.6	331.3	308.9
14:00	839.2	620.0	413.1	373.7	345.9	327.6	345.7	329.3	307.1
SHIFT AVG.	842.4	629.5	382.1	374.8	346.8	327.7	346.8	328.3	305.8
15:00	837.6	615.0	422.5	373.3	344.4	326.2	343.5	328.0	305.5
16:00	842.7	622.9	423.3	374.9	344.7	325.6	345.3	327.7	304.3
17:00	844.5	633.2	423.8	375.5	347.4	326.7	347.9	327.8	305.2
18:01	844.3	625.9	423.7	374.4	345.6	326.8	346.2	327.8	305.0
19:00	838.5	607.7	418.3	370.0	344.4	325.2	342.3	324.8	302.4
20:01	845.3	618.6	422.9	371.0	346.0	326.2	344.9	326.7	303.4
21:00	851.6	625.4	420.5	371.8	345.5	325.7	345.2	326.6	302.4
22:01	874.5	647.3	421.6	375.3	349.7	328.3	352.4	330.9	306.4
SHIFT AVG.	847.4	624.5	422.1	373.3	346.0	326.3	346.0	327.5	304.3
23:00	875.9	661.5	420.6	378.9	348.9	329.5	354.5	334.6	308.9
0:00	871.6	653.1	417.8	378.8	348.8	330.7	352.4	334.8	309.7
1:00	842.6	630.1	413.5	374.6	343.8	328.7	344.4	330.3	307.2
2:00	852.5	612.2	411.3	382.9	342.2	325.9	341.8	326.9	304.8
3:00	857.1	623.8	420.7	397.0	344.7	327.1	346.1	328.7	306.7
4:00	859.5	635.3	416.6	397.9	344.8	328.4	345.4	329.6	308.4
5:00	866.7	636.6	414.8	394.6	342.8	327.2	345.3	329.3	307.3
6:00	851.5	627.4	412.7	393.3	346.2	328.6	347.4	329.3	308.0
SHIFT AVG.	858.7	635.0	416.0	387.3	345.3	328.3	347.2	330.4	307.6
DAILY AVG.	849.6	629.6	406.7	378.4	346.0	327.4	346.6	328.8	305.9

24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE 2/27/85 TIME 6:10 DATA DATE 2/27/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 C

FURNACE DRAFTS

TIME (HR:MIN)	FURNACE DRAFT (IN H2O)	SH INTER. DRAFT (IN H2O)	BOILER IN DRAFT (IN H2O)	BOILER INT DRAFT (IN H2O)	BOILER OUT DRAFT (IN H2O)	ECON OUT DRAFT (IN H2O)	UPPER CAS OUTLET (IN H2O)	LOWER CASCADE OUTLET (IN H2O)
7:00	-0.4	2.4	-0.5	4.8	6.2	-1.9	-3.7	-3.7
8:00	-0.4	2.4	-0.4	4.9	6.2	-1.8	-3.6	-3.5
9:00	-0.4	2.7	-0.5	5.2	6.2	-1.9	-3.6	-3.6
10:00	-0.4	3.1	-0.5	5.6	6.2	-1.9	-3.7	-3.7
11:00	-0.4	3.7	-0.5	6.2	6.2	-2.0	-3.8	-3.8
12:00	-0.5	3.9	-0.5	6.5	6.2	-2.2	-4.1	-4.1
13:00	-0.4	6.2	-0.5	8.5	6.2	-2.0	-4.0	-3.9
14:00	-0.4	6.2	-0.4	9.0	6.2	-1.9	-3.7	-3.7
SHIFT AVG.	-0.4	3.8	-0.5	6.3	6.2	-1.9	-3.8	-3.8
15:00	-0.4	6.8	-0.5	9.8	6.2	-1.9	-3.8	-3.6
16:00	-0.4	6.9	-0.5	10.1	6.2	-1.9	-3.8	-3.7
17:00	-0.4	6.2	-0.5	9.4	6.2	-2.0	-3.8	-3.8
10:01	-0.4	5.2	-0.4	8.6	6.2	-1.8	-3.7	-3.6
19:00	-0.4	3.8	-0.5	7.4	6.2	-1.8	-3.6	-3.6
20:01	-0.4	2.1	-0.5	5.8	6.2	-1.9	-3.7	-3.7
21:00	-0.4	0.4	-0.5	3.9	6.2	-2.0	-3.8	-3.7
22:01	-0.4	-0.5	-0.5	2.8	6.2	-2.2	-4.2	-4.2
SHIFT AVG.	-0.4	3.9	-0.5	7.2	6.2	-1.9	-3.8	-3.7
23:00	-0.5	-0.6	-0.5	2.1	6.2	-2.2	-4.3	-4.2
0:00	-0.5	-0.7	-0.5	1.3	6.2	-2.1	-4.0	-4.0
1:00	-0.5	-0.6	-0.6	1.1	6.2	-2.0	-3.9	-3.9
2:00	-0.5	-0.7	-0.6	0.8	6.2	-2.0	-3.9	-3.9
3:00	-0.5	-0.3	-0.5	0.6	6.2	-2.1	-4.1	-4.0
4:00	-0.5	-0.2	-0.5	0.8	6.2	-2.2	-4.3	-4.2
5:00	-0.5	-0.1	-0.5	0.8	6.2	-2.0	-4.0	-3.9
6:00	-0.5	-0.6	-0.6	-0.2	6.2	-2.0	-4.0	-3.9
SHIFT AVG.	-0.5	-0.5	-0.5	0.9	6.2	-2.1	-4.1	-4.0
DAILY AVG.	-0.4	2.4	-0.5	4.8	6.2	-2.0	-3.9	-3.8

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24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE 2/27/85 TIME 6:20 DATA DATE 2/27/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 C

BLACK LIQUOR

TIME (HR:MIN)	BL PRESSURE (PSI)	PRIM BL HEATER TEMP (DEGF)	SEC BL HEATER TEMP (DEGF)	BL FLOW (GPM)	LBS SOLIDS BURNED (MPPH)	NO. SPRAYS	METER AVG. %BLS	TESTER % BLS	UPPER MOTOR LOAD (%)	LOWER MOTOR LOAD (%)	CHEM ASH TK BL PRESSURE (PSI)
7:00	26.	222.	260.	261.	125.1	7.	68.4	69.8	36.2	36.2	41.
8:00	26.	221.	258.	260.	125.1	7.	68.4	70.0	37.2	36.8	41.
9:00	26.	220.	259.	260.	126.1	7.	68.1	70.4	37.2	36.4	41.
10:00	26.	221.	260.	261.	125.0	7.	68.3	69.7	37.4	36.3	41.
11:00	26.	222.	260.	261.	125.0	7.	68.7	69.7	37.2	36.8	41.
12:00	27.	224.	260.	261.	124.0	7.	69.1	69.2	38.1	36.8	41.
13:00	27.	224.	258.	261.	123.9	7.	69.2	69.2	37.5	36.5	41.
14:00	26.	222.	259.	259.	126.1	7.	68.4	70.6	36.1	36.3	41.
SHIFT AVG.	26.	222.	259.	260.	125.1	7.	68.6	69.8	37.1	36.5	41.
SHIFT TOTAL				125025. GAL1000.4 M-LBS							
15:00	26.	221.	260.	258.	126.5	7.	68.5	71.0	36.9	37.0	40.
16:00	26.	222.	260.	256.	125.0	7.	68.8	70.7	37.0	37.3	40.
17:00	27.	223.	260.	258.	125.7	7.	69.0	70.6	37.1	36.6	40.
18:01	27.	223.	258.	258.	126.1	7.	68.9	70.7	36.8	36.0	41.
19:00	26.	221.	260.	258.	126.9	7.	68.5	71.1	36.0	36.3	41.
20:01	26.	222.	260.	255.	124.8	7.	68.7	70.8	36.8	36.8	41.
21:00	26.	222.	260.	258.	124.5	7.	68.9	70.2	36.8	37.0	41.
22:01	26.	224.	260.	257.	124.2	7.	69.2	70.2	37.4	37.2	41.
SHIFT AVG.	26.	222.	260.	257.	125.5	7.	68.8	70.7	36.9	36.8	41.
SHIFT TOTAL				123457. GAL1003.6 M-LBS							
23:00	26.	226.	259.	256.	123.8	7.	69.6	70.2	37.0	37.4	42.
0:00	26.	225.	259.	255.	123.9	7.	69.4	70.4	34.8	37.4	42.
1:00	26.	224.	259.	255.	123.8	7.	70.0	70.4	35.7	38.1	42.
2:00	27.	223.	259.	256.	123.7	7.	69.5	70.3	37.0	37.0	42.
3:00	26.	224.	259.	254.	123.4	7.	70.0	70.4	37.2	36.5	42.
4:00	26.	227.	258.	253.	123.5	7.	70.5	70.6	36.7	38.4	41.
5:00	24.	227.	258.	252.	123.9	7.	70.1	71.0	36.5	37.1	42.
6:00	24.	226.	258.	253.	124.8	7.	69.1	71.3	36.1	37.3	42.
SHIFT AVG.	26.	225.	259.	254.	123.9	7.	69.8	70.6	36.4	37.4	42.
SHIFT TOTAL				122080. GAL 990.9 M-LBS							
DAILY AVG.	26.	223.	259.	257.	124.8	7.	69.1	70.4	36.8	36.9	41.
DAILY TOTAL				370561. GAL2994.9 M-LBS							

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                          24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

    DATE  2/27/85  TIME  6:23  DATA DATE  2/27/85
    SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 C

                         FUEL OIL
                                                            TANK LEVELS
      TIME        OIL       OIL     FUEL OIL    50% BL  PRECIPITATOR  DUMP      NORTH     SOUTH
                PRESSURE    TEMP     BURNED     STORAGE    LEVEL      TANK    DISSOLVER DISSOLVER
    (HR:MIN)     (PSI)     (DEGF)    (MPPH)      (FT)     (INCHES)    (FT)      (FT)      (FT)

      7:00         6.       119.       0.0      -999.0     -999.0      2.8       0.8       2.8
      8:00         6.       115.       0.0      -999.0     -999.0      3.0       1.4       2.8
      9:00         4.       121.       0.0      -999.0     -999.0      3.0       1.4       2.8
     10:00         3.       122.       0.0      -999.0     -999.0      3.1       1.4       2.7
     11:00        45.       130.       0.0      -999.0     -999.0      3.0       1.4       2.8
     12:00        66.       135.       0.0      -999.0     -999.0      3.0       1.4       2.8
     13:00        65.       140.       0.0      -999.0     -999.0      3.2       1.4       2.8
     14:00        64.       147.       0.0      -999.0     -999.0      3.2       1.4       2.8

    SHIFT AVG.    32.       129.       0.0      -999.0     -999.0      3.0       1.3       2.8

    SHIFT TOTAL(M-LBS)                 0.0

     15:00        64.       149.       0.0      -999.0     -999.0      3.5       1.4       2.8
     16:00        62.       152.       0.0      -999.0     -999.0      3.6       1.6       2.8
     17:00        59.       158.       0.0      -999.0     -999.0      3.4       1.6       2.8
     18:01        58.       159.       0.0      -999.0     -999.0      3.4       1.6       2.8
     19:00        57.       159.       0.0      -999.0     -999.0      3.3       1.6       2.9
     20:01        56.       159.       0.0      -999.0     -999.0      3.4       1.5       2.8
     21:00        55.       159.       0.0      -999.0     -999.0      3.4       1.5       2.8
     22:01        53.       159.       0.0      -999.0     -999.0      3.5       1.1       2.8

    SHIFT AVG.    58.       157.       0.0      -999.0     -999.0      3.4       1.5       2.8

    SHIFT TOTAL(M-LBS)                 0.0

     23:00        52.       159.       0.0      -999.0     -999.0      3.6       0.8       2.8
      0:00        51.       159.       0.0      -999.0     -999.0      3.6       0.8       2.8
      1:00        51.       158.       0.0      -999.0     -999.0      3.7       0.8       2.8
      2:00        50.       157.       0.0      -999.0     -999.0      3.7       0.8       2.7
      3:00        50.       158.       0.0      -999.0     -999.0      3.8       0.8       2.8
      4:00        50.       158.       0.0      -999.0     -999.0      3.8       0.8       2.8
      5:00        68.       158.       0.0      -999.0     -999.0      3.8       0.8       2.9
      6:00        66.       158.       0.0      -999.0     -999.0      3.9       0.7       2.9

    SHIFT AVG.    55.       158.       0.0      -999.0     -999.0      3.7       0.8       2.8

    SHIFT TOTAL(M-LBS)                 0.0

    DAILY AVG.    48.       148.       0.0      -999.0     -999.0      3.4       1.2       2.8

    DAILY TOTAL(M-LBS)                 0.0
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2/27/85                 RECOVERY ON CONTROL SUMMARY

                                NO.4                                NO.5
                                (%)                                 (%)

 * BY SHIFT *      7-3 B       3-11 A      11-7 C         7-3 B       3-11 A      11-7 C

 CONSUMED AIR       98.0       100.0       100.0           98.0       100.0       100.0
 OPTIMUM O2         98.0       100.0       100.0           95.9        98.0       100.0
  TARGET THRUPUT    98.0       100.0       100.0            0.0         0.0         0.0

  *** TOTAL ***                NO.4                                   NO.5

 CONSUMED AIR                  99.4 %                                 99.4 %
 OPTIMUM O2                    99.4 %                                 98.0 %
  TARGET THRUPUT               99.4 %                                  0.0 %


                               RECOVERY UTILIZATION

                               NO.4                                   NO.5

 * BY SHIFT *      7-3 B       3-11 A      11-7 C         7-3 B       3-11 A      11-7 C

 TIME OFF LIQUOR   0.0 HRS     0.0 HRS     0.0 HRS        0.0 HRS     0.0 HRS     0.0 HRS

 % OF MAX LOAD     116.4 %     116.3 %     115.5 %        107.1 %     111.0 %     109.6 %


 *** TOTAL ***                 NO.4                                   NO.5

 TIME OFF LIQUOR               0.0 HRS                                0.0 HRS

 % OF MAX LOAD                 116.0 %                                109.2 %

 TIME  7:36                             'V. PULP & PAPER CO.
                               RECOVERY BOILER PERFORMANCE REPORT
                                        FOR  2/27/85

                          #4 RECOVERY BOILER              #5 RECOVERY BOILER
                           AVG.          TOTAL             AVG.           TOTAL

 BLACK LIQUOR FLOW        257.1 GAL    370154. GAL        364.8 GAL      525282. GAL
 % BLACK LIQ. SOLIDS       70.4 %                          66.3 %

 TOTAL SOLIDS BURNED      124.8 MLBS     2.995 MMLBS      164.5 MLBS       3.947 MMLBS
 TOTAL SOLIDS TARGET      112.5 MLBS     2.701 MMLBS      162.5 MLBS       3.900 MMLBS
 % OF TARGET BURNED                      110.9 %                           101.2 %

 STEAM PRODUCED           364.8 MLBS     8755. MLBS       534.0 MLBS       12815. MLBS
 LB. STEAM / LB. BLS        2.736                           3.246
```

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                                          SYSTEM  DAILY STATUS REPORT
                                           DATE: 2/26/85 TIME: 5: 5:22
SYSTEM UP

EMERGENCY SHUTDOWN : NONE

#4 BOILER  UP
#5 BOILER  UP
CONTROL PROGRAM STATUS : NORMAL
```

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BOILER #4 SH TC TEMPERATURE
                  INTERMEDIATE FRONT
                    LOOP A    LOOP D

   ROW  1            674        754
   ROW  2            676        796
   ROW  3            686        795
   ROW  4            704        781
   ROW  5            716        722
   ROW  6            726        828
   ROW  7            723        819
   ROW  8            729        827
   ROW  9            736        812
   ROW 10            725        846
   ROW 11            728        780
   ROW 12            758        843
   ROW 13            763        853
   ROW 14            780        782
   ROW 15            722        785
   ROW 16            749        725
   ROW 17            777        814
   ROW 18            760        786

CONSUMABLE=  -999.0 INTERM. AVG.=   729.9 FRONT  AVG.=   797.4
 STEAM TEMP=   823.1 DRUM PRESSURE=   146.0
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                                BOILER #5 SH TC TEMPERATURE
          SECONDARY           PRIMARY                         SECONDARY           PRIMARY
          LOOP B  LOOP A    LOOP B  LOOP A                  LOOP B  LOOP A    LOOP B  LOOP A

ROW  1     777     762        692     682    ROW 18          843     826       762     752
ROW  2     797     794        754     708    ROW 19          834     817       703     695
ROW  3     846     830        773     771    ROW 20          821    ·807       728     717
ROW  4     801     869       -999    -999    ROW 21          814     803       703     709
ROW  5     891     876       -999    -999    ROW 22          818     810       728     719
ROW  6     877     860        808     811    ROW 23          817     811       700     691
ROW  7     892     893        761     765    ROW 24          841     831       727     712
ROW  8     860     849        792     750    ROW 25          840     841       696     700
ROW  9     833     814        738     734    ROW 26         -999     838       721     706
ROW 10     844     831        750     775    ROW 27          808     820       696     692
ROW 11     839     814        741     736    ROW 28          816     830       696     702
ROW 12     841     826        768     750    ROW 29          809     811       700     688
ROW 13     823     823        719     720    ROW 30          805     813       707     681
ROW 14     822     820        749     741    ROW 31          798     792       683     683
ROW 15     846     825        721     696    ROW 32          803     797       693     695
ROW 16     832     827        753     714    ROW 33          795     790       672     658
ROW 17     838     823        716     691    ROW 34          770     775       654     633

OUTLET TEMP    826. PRESS  1065. CONSUMABL     69. SEC AVG  824. PRI AVG  724.
```

24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE 2/26/85 TIME 6:10 DATA DATE 2/26/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 D

	PERFORMANCE	GREEN LIQUOR			STEAM				FLUE GAS		
TIME (HR:MIN)	LB STEAM/ LB BLS	NORTH A TEST (LB NA2O/ GAL.)	SULFIDITY (%)	SOUTH A TEST (LB NA2O/ GAL.)	STEAM TEMP (DEGF)	STEAM FLOW (MPPH)	SOOTBLOWING STEAM (MPPH)	FEEDWATER FLOW (MPPH)	PER CENT OXYGEN (%)	CONSUMED AIR (MPPH)	CARBON MONOXIDE (PPM)
7:00	2.673	10.4	21.3	9.5	825.	337.	13.2	352.	2.65	550.60	1000.00
8:00	2.830	10.4	21.3	9.5	822.	338.	13.0	349.	3.28	523.66	986.37
9:00	2.668	10.4	21.3	9.5	829.	336.	13.3	349.	2.36	563.97	993.25
10:00	2.759	9.8	22.3	9.7	823.	338.	13.2	356.	2.66	552.21	986.13
11:00	2.849	9.8	22.4	9.6	825.	346.	13.0	362.	3.26	539.13	852.62
12:00	2.856	9.7	22.4	9.5	825.	347.	12.8	357.	2.84	551.21	960.51
13:00	2.808	9.4	22.4	9.8	832.	344.	13.1	349.	2.70	561.68	984.73
14:01	2.813	8.3	22.4	9.9	827.	347.	12.6	362.	3.52	545.37	983.23
SHIFT AVG.	2.782	9.9	22.0	9.6	826.	342.	13.0	355.	2.92	548.48	968.36
SHIFT TOTAL (M-LBS)						2733.	104.1	2836.			
15:00	2.738	9.3	22.4	9.7	824.	339.	13.2	348.	2.71	553.42	990.62
16:01	2.630	9.5	23.0	9.8	822.	329.	12.7	343.	2.06	582.49	989.37
17:01	2.648	8.9	24.6	9.9	825.	335.	10.6	342.	2.70	550.75	990.12
18:01	2.692	9.9	24.6	9.7	827.	340.	13.0	354.	3.69	511.13	990.58
19:00	2.802	9.9	24.6	9.3	823.	364.	13.2	350.	2.89	546.18	990.98
20:00	2.807	10.1	24.6	9.7	824.	359.	12.7	335.	2.39	565.93	989.22
21:00	2.796	10.1	24.6	9.8	823.	351.	13.9	333.	1.92	585.70	990.73
22:00	2.896	10.1	24.6	9.8	827.	363.	12.8	340.	1.81	594.72	994.44
SHIFT AVG.	2.774	9.8	24.1	9.7	824.	348.	12.8	343.	2.52	561.29	990.76
SHIFT TOTAL (M-LBS)						2780.	102.0	2744.			
23:00	2.862	10.1	24.6	9.8	827.	358.	12.8	333.	1.62	599.58	993.74
0:00	2.817	10.1	24.6	9.8	820.	352.	13.2	329.	1.73	595.81	995.44
1:00	2.747	10.1	24.6	9.8	832.	345.	13.3	326.	1.76	593.89	986.02
2:00	2.839	9.7	23.1	9.7	821.	349.	12.5	332.	1.58	606.76	984.89
3:00	2.909	9.5	22.2	9.7	824.	354.	13.7	339.	1.76	605.80	985.82
4:00	2.964	9.5	22.2	9.7	825.	363.	12.8	342.	1.62	615.96	988.32
5:00	2.857	9.5	22.2	9.7	824.	349.	13.0	343.	1.96	601.96	990.46
6:00	2.557	9.8	22.2	9.9	821.	319.	12.9	336.	1.53	611.45	994.65
SHIFT AVG.	2.819	9.8	23.2	9.8	824.	349.	13.0	335.	1.69	603.90	989.92
SHIFT TOTAL (M-LBS)						2789.	104.2	2680.			
DAILY AVG.	2.791	9.8	23.1	9.7	825.	346.	12.9	344.	2.38	571.22	983.01
DAILY TOTAL (M-LBS)						8302.	310.3	8261.			

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                      24 HOUR SUMMARY REPORT - NO. 4 RECOVERY
                                      *
DATE  2/26/85  TIME  6:13  DATA DATE  2/20/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 D

                  AIR PRESSURES                      AIR FLOWS

  TIME    FD OUTLET  MAIN DUCT PRIMARY   SECONDARY  PRIMARY    TOTAL   ID FAN      AIR
                               DUCT      DUCT       AIR        AIR     SPEED       HEATER
(HR:MIN) (IN H2O)   (IN H2O)  (IN H2O)  (IN H2O)   (MPPH)     (MPPH)  (RPM)       (DEGF)
   7:00   -999.0      9.5       0.1       7.6        27.        61.     307.        260.
   8:00   -999.0      9.4       0.4       7.5        27.        62.     305.        262.

   9:00   -999.0      9.1       0.0       7.4        27.        62.     312.        264.
  10:00   -999.0      9.0       0.5       7.3        27.        62.     297.        266.
  11:00   -999.0      9.0       0.1       7.4        29.        63.     308.        266.
  12:00   -999.0      9.2       0.7       7.4        29.        63.     309.        266.
  13:00   -999.0      9.8       1.2       7.7        29.        63.     313.        266.
  14:01   -999.0     10.2       0.5       7.8        29.        65.     328.        267.

SHIFT AVG.-999.0      9.4       0.4       7.5        28.        63.     310.        265.

SHIFT TOTAL(M-LBS)                                   225.       500.

  15:00   -999.0     10.6       0.6       8.0        27.        62.     313.        270.
  16:01   -999.0     10.3       1.4       7.8        27.        62.     288.        268.
  17:01   -999.0     10.1       1.2       7.7        27.        62.     286.        269.
  18:01   -999.0     10.1       0.6       7.7        27.        62.     311.        271.
  19:00   -999.0      9.8       0.9       7.6        27.        62.     310.        268.
  20:00   -999.0      9.8       0.9       7.6        27.        62.     298.        269.
  21:00   -999.0      9.2       1.0       7.3        27.        62.     291.        272.
  22:00   -999.0      9.2       0.5       7.3        28.        63.     291.        271.

SHIFT AVG.-999.0      9.9       0.9       7.6        27.        62.     298.        269.

SHIFT TOTAL(M-LBS)                                   217.       497.

  23:00   -999.0      9.0       0.8       7.2        27.        63.     293.        270.
   0:00   -999.0      8.9       1.2       7.2        27.        63.     292.        268.
   1:00   -999.0      8.8       0.4       7.2        27.        63.     298.        267.
   2:00   -999.0      8.9       0.9       7.2        28.        63.     300.        269.
   3:00   -999.0      8.9       0.5       7.2        28.        64.     298.        267.
   4:00   -999.0      9.1       0.9       7.3        28.        64.     292.        266.
   5:00   -999.0      9.0       0.6       7.3        29.        64.     299.        263.
   6:00   -999.0      9.0       0.6       7.3        28.        63.     299.        265.

SHIFT AVG.-999.0      8.9       0.7       7.2        28.        63.     296.        267.

SHIFT TOTAL(M-LBS)                                   223.       506.


DAILY AVG.-999.0      9.4       0.7       7.5        28.        63.     301.        267.

DAILY TOTAL(M-LBS)                                   665.      1503.
```

24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE 2/26/85 TIME 6:16 DATA DATE 2/26/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 D

	AIR TEMPERATURES				FLAKT PRECIP.				
TIME (HR:MIN)	ECON INLET (DEGF)	ECON OUTLET (DEGF)	UPPER CASCADE (DEGF)	LOWER CASCADE (DEGF)	NORTH INLET (DEGF)	NORTH OUTLET (DEGF)	SOUTH INLET (DEGF)	SOUTH OUTLET (DEGF)	ID FAN INLET (DEGF)
7:00	825.8	621.5	358.4	380.5	351.4	331.3	349.5	332.4	305.8
8:00	830.1	630.2	360.9	381.4	349.0	330.9	349.2	332.5	305.7
9:00	830.0	634.7	359.8	383.0	350.5	331.6	351.6	332.8	306.1
10:00	820.0	619.8	357.0	380.8	344.7	329.6	345.5	329.9	303.3
11:00	828.8	609.7	354.5	378.0	346.4	327.2	346.3	327.8	301.8
12:00	836.6	625.2	360.8	380.0	349.8	330.1	347.3	329.2	304.3
13:00	836.2	633.8	360.4	381.1	348.3	329.7	349.9	330.4	305.0
14:01	860.7	660.7	362.6	384.3	353.3	332.2	354.9	335.6	309.5
SHIFT AVG.	834.5	629.4	358.3	381.1	349.2	330.3	349.3	331.3	305.2
15:00	851.7	663.0	362.7	384.2	349.9	332.9	348.5	336.0	310.7
16:01	802.1	620.8	355.6	377.3	343.9	327.3	343.0	329.4	305.7
17:01	835.0	611.0	352.8	378.2	346.5	326.4	341.8	326.6	303.8
18:01	854.8	635.9	358.9	386.0	352.3	332.5	352.7	333.6	309.9
19:00	849.8	650.2	360.4	385.1	352.1	333.9	350.1	334.3	310.0
20:00	836.8	643.5	358.7	381.9	348.8	333.5	348.6	331.9	308.2
21:00	831.7	627.3	357.3	377.5	346.1	329.2	342.6	327.0	303.9
22:00	825.6	602.7	354.5	373.7	332.2	324.9	338.7	322.3	299.4
SHIFT AVG.	835.9	631.8	357.6	380.5	346.6	330.1	345.8	330.1	306.5
23:00	796.4	608.2	357.6	373.6	345.9	327.4	342.8	324.5	301.5
0:00	805.7	616.7	356.3	374.4	345.6	327.5	344.6	325.6	302.7
1:00	829.3	637.3	357.8	376.5	346.8	328.0	348.9	328.8	305.5
2:00	831.7	651.2	360.3	380.3	348.1	329.9	350.1	331.2	307.5
3:00	830.4	637.8	358.8	380.1	346.3	329.1	347.5	329.5	305.8
4:00	820.0	609.1	353.5	374.5	342.3	325.2	341.6	325.3	301.3
5:00	828.3	614.1	359.9	376.5	346.4	327.5	346.6	326.8	302.9
6:00	837.7	624.6	378.3	376.9	345.2	327.0	345.6	326.9	303.1
SHIFT AVG.	822.4	624.9	360.3	376.6	345.8	327.7	346.0	327.3	303.8
DAILY AVG.	831.0	628.7	359.1	379.[illegible]	347.2	329.4	347.0	329.6	305.1

24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE 2/26/85 TIME 6:10 DATA DATE 2/26/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 D

FURNACE DRAFTS

TIME (HR:MIN)	FURNACE DRAFT (IN H2O)	SH INTER. DRAFT (IN H2O)	BOILER IN DRAFT (IN H2O)	BOILER INT DRAFT (IN H2O)	BOILER OUT DRAFT (IN H2O)	ECON OUT DRAFT (IN H2O)	UPPER CAS OUTLET (IN H2O)	LOWER CASCADE OUTLET (IN H2O)
7:00	-0.6	4.8	-0.6	3.5	0.1	-2.0	-3.9	-3.9
8:00	-0.6	4.5	-0.6	3.3	-0.1	-2.0	-4.0	-4.0
9:00	-0.6	5.4	-0.6	4.1	0.4	-2.0	-4.0	-4.0
10:00	-0.6	6.9	-0.6	5.5	1.4	-1.8	-3.8	-3.8
11:00	-0.5	11.3	-0.6	10.1	5.0	-2.0	-3.9	-3.9
12:00	-0.5	12.7	-0.6	11.6	6.0	-2.0	-3.9	-3.9
13:00	-0.5	12.3	-0.6	11.7	6.2	-2.0	-4.0	-4.0
14:01	-0.5	11.0	-0.5	11.8	6.2	-2.1	-4.2	-4.2
SHIFT AVG.	-0.5	8.6	-0.6	7.7	3.1	-2.0	-4.0	-4.0
15:00	-0.4	10.6	-0.4	11.6	6.2	-1.9	-3.9	-3.9
16:01	-0.4	7.3	-0.5	8.7	6.2	-1.8	-3.4	-3.4
17:01	-0.4	4.7	-0.4	6.2	6.2	-1.8	-3.4	-3.4
18:01	-0.4	4.1	-0.4	5.7	6.2	-1.9	-3.9	-3.8
19:00	-0.3	1.9	-0.4	3.5	6.2	-1.9	-3.8	-3.8
20:00	-0.3	2.1	-0.4	3.7	6.2	-1.8	-3.6	-3.6
21:00	-0.4	1.5	-0.4	3.2	6.2	-1.8	-3.4	-3.5
22:00	-0.4	1.5	-0.4	3.2	6.2	-1.7	-3.5	-3.5
SHIFT AVG.	-0.4	4.2	-0.4	5.7	6.2	-1.8	-3.6	-3.6
23:00	-0.4	1.7	-0.4	3.5	6.2	-1.8	-3.5	-3.5
0:00	-0.4	3.1	-0.5	4.9	6.2	-1.8	-3.5	-3.5
1:00	-0.4	3.4	-0.4	5.4	6.2	-1.8	-3.6	-3.6
2:00	-0.4	3.2	-0.5	5.2	6.2	-1.9	-3.6	-3.6
3:00	-0.4	3.7	-0.5	5.9	6.2	-1.8	-3.6	-3.5
4:00	-0.4	3.8	-0.5	6.0	6.2	-1.8	-3.5	-3.5
5:00	-0.4	3.4	-0.4	5.7	6.2	-1.8	-3.6	-3.6
6:00	-0.4	2.9	-0.4	5.3	6.2	-1.9	-3.6	-3.6
SHIFT AVG.	-0.4	3.1	-0.4	5.2	6.2	-1.8	-3.6	-3.6
DAILY AVG.	-0.4	5.3	-0.5	6.2	5.2	-1.9	-3.7	-3.7

24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE 2/26/85 TIME 6:20 DATA DATE 2/26/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 D

BLACK LIQUOR

TIME (HR:MIN)	BL PRESSURE (PSI)	PRIM BL HEATER TEMP (DEGF)	SEC BL HEATER TEMP (DEGF)	BL FLOW (GPM)	LBS SOLIDS BURNED (MPPH)	NO. SPRAYS	METER AVG. %BLS	TESTER % BLS	UPPER MOTOR LOAD (%)	LOWER MOTOR LOAD (%)	CHEM ASH TK BL PRESSURE (PSI)
7:00	27.	221.	259.	264.	125.8	7.	67.6	69.5	34.6	36.8	41.
8:00	27.	224.	259.	250.	119.5	7.	68.1	69.5	35.6	37.7	40.
9:00	26.	223.	259.	265.	126.2	7.	68.0	69.5	35.2	36.7	42.
10:00	27.	222.	259.	259.	122.2	7.	67.8	69.0	35.5	37.3	41.
11:00	27.	221.	260.	257.	121.4	7.	67.8	68.9	35.5	37.5	41.
12:00	27.	223.	260.	257.	121.4	7.	68.1	68.9	35.2	37.7	41.
13:00	28.	224.	260.	257.	122.6	7.	68.4	69.4	35.5	37.8	40.
14:01	29.	225.	260.	258.	123.1	7.	68.7	69.5	35.5	37.4	40.
SHIFT AVG.	27.	223.	259.	258.	122.8	7.	68.1	69.3	35.3	37.4	41.
SHIFT TOTAL				124000. GAL	982.1 M-LBS						
15:00	29.	225.	259.	260.	124.1	7.	68.5	69.4	35.5	37.1	40.
16:01	28.	221.	259.	259.	124.8	7.	67.9	70.0	35.0	36.6	40.
17:01	28.	219.	259.	255.	126.4	7.	67.7	71.6	35.0	37.6	40.
18:01	28.	223.	260.	256.	126.2	7.	68.4	71.3	35.2	37.4	41.
19:00	29.	224.	259.	258.	125.3	7.	68.8	70.5	35.3	37.2	41.
20:00	28.	223.	259.	255.	124.3	7.	68.2	70.6	35.2	37.3	41.
21:00	28.	221.	259.	257.	125.1	7.	68.2	70.6	35.3	36.9	41.
22:00	29.	219.	259.	257.	125.4	7.	68.2	70.6	35.5	36.5	41.
SHIFT AVG.	28.	222.	259.	257.	125.2	7.	68.2	70.6	35.2	37.1	41.
SHIFT TOTAL				123461. GAL	1001.6 M-LBS						
23:00	28.	220.	260.	257.	125.0	7.	68.3	70.6	35.6	37.1	41.
0:00	28.	220.	259.	256.	124.9	7.	68.0	70.6	35.6	36.5	40.
1:00	28.	221.	259.	257.	125.5	7.	68.0	70.6	35.5	36.4	40.
2:00	27.	222.	259.	255.	122.8	7.	68.3	69.9	35.4	36.9	40.
3:00	27.	222.	259.	255.	121.6	7.	68.4	69.5	35.8	36.9	41.
4:00	28.	219.	259.	256.	122.4	7.	67.9	69.5	36.1	36.5	41.
5:00	28.	220.	260.	256.	122.4	7.	67.9	69.5	35.6	36.3	41.
6:00	26.	221.	259.	260.	124.7	7.	68.2	69.8	36.0	36.5	41.
SHIFT AVG.	28.	221.	259.	257.	123.7	7.	68.1	70.0	35.7	36.6	41.
SHIFT TOTAL				123197. GAL	989.4 M-LBS						
DAILY AVG.	28.	222.	259.	257.	123.9	7.	68.1	69.9	35.4	37.0	41.
DAILY TOTAL				370658. GAL	2973.1 M-LBS						

```
                       24 HOUR SUMMARY REPORT - NO. 4 RECOVERY

DATE  2/26/85  TIME  6:23  DATA DATE  2/26/85
SHIFT ASSIGNMENTS 7-3 B, 3-11 A, 11-7 D

                FUEL OIL                                TANK LEVELS

   TIME       OIL        OIL     FUEL OIL    50% BL  PRECIPITATOR DUMP
            PRESSURE     TEMP     BURNED    STORAGE     LEVEL      TANK        NORTH      SOUTH
  (HR:MIN)   (PSI)      (DEGF)    (MPPH)     (FT)     (INCHES)    (FT)    DISSOLVER  DISSOLVER
                                                                             (FT)        (FT)

    7:00      16.       108.       0.0     -999.0    -999.0       2.1        0.9        2.8

    8:00      15.       114.       0.0     -999.0    -999.0       1.8        0.9        2.8
    9:00      14.       126.       0.0     -999.0    -999.0       1.9        0.8        2.8
   10:00      13.       128.       0.0     -999.0    -999.0       1.8        0.8        2.8
   11:00      12.       126.       0.0     -999.0    -999.0       2.0        1.3        2.8
   12:00      12.       128.       0.0     -999.0    -999.0       2.0        1.1        2.8
   13:00      13.       132.       0.0     -999.0    -999.0       2.0        1.2        2.9
   14:01      13.       136.       0.0     -999.0    -999.0       2.1        1.2        2.9

 SHIFT AVG.   14.       125.       0.0     -999.0    -999.0       2.0        1.0        2.8

 SHIFT TOTAL(M-LBS)                0.0

   15:00      13.       136.       0.0     -999.0    -999.0       2.2        1.0        2.9
   16:01      14.       136.       0.0     -999.0    -999.0       2.3        1.2        2.9
   17:01      12.       132.       0.0     -999.0    -999.0       2.2        1.3        2.8
   18:01      10.       130.       0.0     -999.0    -999.0       2.4        1.5        2.8
   19:00       8.       130.       0.0     -999.0    -999.0       2.1        1.7        2.7
   20:00       7.       129.       0.0     -999.0    -999.0       2.1        0.9        2.8
   21:00       7.       128.       0.0     -999.0    -999.0       2.3        1.0        2.8
   22:00       7.       127.       0.0     -999.0    -999.0       2.2        1.1        2.8

 SHIFT AVG.   10.       131.       0.0     -999.0    -999.0       2.2        1.2        2.8

 SHIFT TOTAL(M-LBS)                0.0

   23:00       7.       126.       0.0     -999.0    -999.0       2.4        1.1        2.8
    0:00       7.       125.       0.0     -999.0    -999.0       2.5        0.9        2.8
    1:00       6.       124.       0.0     -999.0    -999.0       2.5        1.0        2.8
    2:00       6.       124.       0.0     -999.0    -999.0       2.7        1.0        2.8
    3:00       6.       122.       0.0     -999.0    -999.0       2.7        0.6        2.8
    4:00       6.       121.       0.0     -999.0    -999.0       2.9        0.9        2.8
    5:00       6.       119.       0.0     -999.0    -999.0       2.9        0.7        2.9
    6:00       6.       119.       0.0     -999.0    -999.0       2.7        0.6        2.8

 SHIFT AVG.    6.       122.       0.0     -999.0    -999.0       2.7        0.9        2.8

 SHIFT TOTAL(M-LBS)                0.0


 DAILY AVG.   10.       126.       0.0     -999.0    -999.0       2.3        1.0        2.8

 DAILY TOTAL(M-LBS)                0.0
```

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2/26/85              RECOVERY ON CONTROL SUMMARY

                             NO.4                                 NO.5
                             (%)                                  (%)

 * BY SHIFT *      7-3 B     3-11 A    11-7 D        7-3 B     3-11 A    11-7 D

 CONSUMED AIR       41.7     100.0     100.0         100.0     100.0     100.0
 OPTIMUM O2         41.7     100.0     100.0          73.0      88.0      70.9
  TARGET THRUPUT    41.7     100.0     100.0           0.0       0.0       0.0

  *** TOTAL ***              NO.4                                 NO.5

 CONSUMED AIR                80.6 %                              100.0 %
 OPTIMUM O2                  80.6 %                               80.6 %
  TARGET THRUPUT             80.6 %                                0.0 %


                              RECOVERY UTILIZATION

                             NO.4                                 NO.5

 * BY SHIFT *      7-3 B     3-11 A    11-7 D        7-3 B     3-11 A    11-7 D

 TIME OFF LIQUOR   0.0 HRS   0.0 HRS   0.0 HRS       0.0 HRS   0.0 HRS   0.0 HRS

 % OF MAX LOAD     113.8 %   116.4 %   114.8 %       108.2 %   111.3 %   109.9 %


  *** TOTAL ***              NO.4                                 NO.5

 TIME OFF LIQUOR             0.0 HRS                              0.0 HRS

 % OF MAX LOAD              115.0 %                              110.1 %
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TIME  7:35
                                       PULP & PAPER CO.
                          RECOVERY BOILER PERFORMANCE REPORT
                                      FOR  2/26/85

                         #4 RECOVERY BOILER              #5 RECOVERY BOILER
                          AVG.          TOTAL             AVG.          TOTAL

BLACK LIQUOR FLOW        257.3 GAL    370485. GAL        362.5 GAL    521886. GAL
% BLACK LIQ. SOLIDS       70.0 %                          66.9 %

TOTAL SOLIDS BURNED      123.8 MLBS     2.972 MMLBS      165.4 MLBS     3.970 MMLBS
TOTAL SOLIDS TARGET      112.5 MLBS     2.701 MMLBS      162.5 MLBS     3.900 MMLBS
% OF TARGET BURNED                      110.1 %                         101.8 %

STEAM PRODUCED           367.2 MLBS    8813. MLBS        534.2 MLBS    12821. MLBS
LB. STEAM / LB. BLS       2.709                           3.229
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APPENDIX H-3

ELECTROSTATIC PRECIPITATOR ELECTRICAL DATA

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Date 2-26 Run 01 2-26-85

Time	1500	1600	1657	1735	1815	1903	2012	2105
Boiler Outlet O_2	2.03	1.61	3.1	4.15	3.96	3.2	2.42	1.73
Total Air (K lb/hr)	62.0	61.7	62.0	61.8	63.8	61.7	62.3	62.4
Primary Air (K lb/hr)	26.7	26.6	27.7	27.1	27.2	27.4	27.0	26.9
Secondary Air (K lb/hr)	35.1	35.10	34.3	34.9	36.3	34.3	35.2	35.4
North ESP 1 ~~DC/Amp~~	188 mA/44 kV	143/45	145/46	105/48	110/47	173/47	170/44	
2	186/41	142/42	145/41	188/44	164/43	191/42	197/41	
3	186/36	145/36	117/35	188/37	164/36	191/36	197/36	
4	186/30	142/29	145/29	191/30	167/30	191/30	197/31	
South ESP 7	231/40	218/40	138/44	145/42	147/40	89/46	201/43	
8	325/40	229/39	243/41	270/43	227/42	330/45	355/43	
9	254/35	227/35	249/35	268/36	240/36	330/37	358/35	
10	262/31	229/31	246/31	270/32	251/32	330/33	355/33	
Fuel Oil flow K lb/hr	0	0	0	0	0	0	0	0
Upper cascade outlet	353°F	352	355	357	356	354	358	346

North
AVE. 166.3 mA 34.6 kV
South
AVE 31.[illegible] 31.91 [illegible]

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Date 2-27 Run O2

Time		1112	1301	1423	1515	1633	1719	1808	1920
Boiler Outlet O2		1.54	~~1.54~~ 1.48	1.32	1.28	1.74	1.37	1.42	1.85
Total Air		62.0	~~62.0~~ 63.6	61.4	62.5	62.1	62.7	61.5	63.8
Primary Air		27.3	26.6	26.6	26.4	27.0	28.0	26.9	28.7
Secondary Air		34.8	37.0	34.9	35.7	35.2	34.8	34.6	35.1
N ESP	1	140/43	152/47	161/44	145/44	160/45	145/46	185/43	160/44
	2	178/41	161/41	161/39	145/40	164/40	180/42	208/40	164/40
	3	178/36	161/35	161/35	145/35	164/35	183/35	210/35	164/36
	4	180/31	164/31	161/30	145/30	161/31	180/31	208/31	164/31
S ESP	7	140/42	77/48	204/46	165/43	214/42	107/42	204/41	153/42
	8	287/42	281/44	276/41	270/40	276/40	243/42	336/41	284/41
	9	287/36	284/37	279/36	268/36	273/36	240/36	347/37	281/36
	10	300/33	281/32	279/32	270/32	276/33	240/32	344/34	281/33
Fuel Oil flow		0	0	0	0	0	0	6	0
Upper cascade outlet		—	355	359	356	355	359	356	

North Amp. [illegible] mA [illegible]7.7 mV

South 214.8 mA 31.4 mV

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Date 2/28/85 Run 03

Time		1058	1218	1311	1427	1552	1736
Boiler Outlet O2		1.34	2.06	3.68	~~0.46~~ 2.46	2.65	2.92
Total Air		65.4	65.5	64.8	61.1	62.4	62.2
Primary Air		28.1	27.8	27.8	27.7	27.5	27.6
Secondary Air		37.3	37.5	37.2	33.4	34.9	34.6
North ESP	1	163/46	178/47	74/50 ~~44~~	203/46	35/50	104/42
	2	216/42	178/41	246/45	210/48	259/47	202/43
	3	216/36	178/36	246/36	210/35	205/34	199/34
	4	216/31	180/31	246/32	232/31	259/32	199/31
South ESP	7	196/42	178/31	120/45	251/32	145/43	204/43
	8	333/42	306/44	328/44	377/42	268/42	257/42
	9	328/36	317/36	328/37	388/36	265/36	290/36
	10	330/33	320/34	328/33	418/37	265/32	287/33
Fuel Oil Flow		0	0	0	0	0	0
Upper Cascade Temp.		362	364	364		364	365

North AVE [illegible] 21.4 kV

South [illegible] 3[illegible]

APPENDIX I

FIELD DATA SHEETS

BLB - B
NORTH DUCT

INSIDE FAR WALL TO OUTSIDE OF NIPPLE 95"
NIPPLE LENGTH 6"

EPA METHOD 1

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

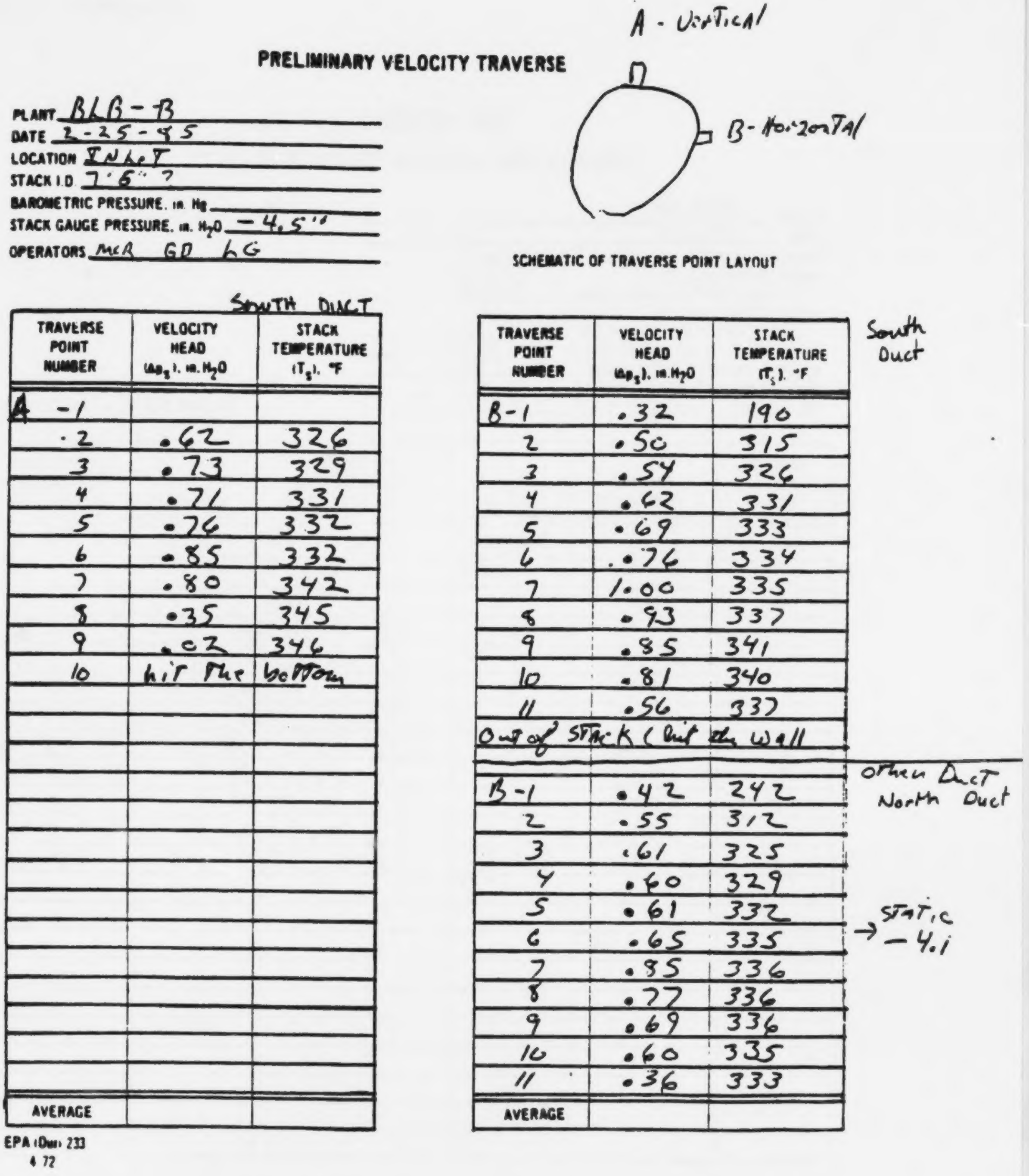
PLANT BLB-B
DATE 2/25/83
SAMPLING LOCATION SOUTH DUCT
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE A) 95½"
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE, (DISTANCE B) 6"
STACK I.D., (DISTANCE A - DISTANCE B) 89½
NEAREST UPSTREAM DISTURBANCE 25'
NEAREST DOWNSTREAM DISTURBANCE 18'
CALCULATOR WEK / MAP

SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH)	DISTANCE B	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	.021	~~95.5~~	~~2.6~~ 1 7/8	6"	8 7 7/8
2	.067	89.5	6 3/8 6		12 3/8 12
3	.118		11 1/4 10 1/2		17 1/4 16 1/2
4	.177		16 7/8 15 7/8		22 7/8 21 7/8
5	.250		23 7/8 22 3/8		29 7/8 28 3/8
6	.356		34 31 7/8		40 37 7/8
7	.644		61 1/2 57 5/8		67 1/2 63 5/8
8	.750		71 5/8 67 1/8		78 5/8 73 1/8
9	.823		78 5/8 73 5/8		84 5/8 79 5/8
10	.882		84 1/4 ~~78~~ 79		90 1/4 85
11	.933		89 1/8 83 1/2		95 1/8 89 1/2
12	.979	~~95.5~~ 89.5	93 1/2 87 5/8	6"	99 1/2 93 5/8

EPA (Dur) 232
4/72

Figure B-3. Traverse point location for circular ducts.



PRELIMINARY VELOCITY TRAVERSE

PLANT BLB - B
DATE 2-25-85
LOCATION INLET
STACK I.D. 7' 6" ?
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O − 4.5"
OPERATORS McR GD LG

A - Vertical

B - Horizontal

SCHEMATIC OF TRAVERSE POINT LAYOUT

SOUTH DUCT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
A -1		
·2	.62	326
3	.73	329
4	.71	331
5	.76	332
6	.85	332
7	.80	342
8	.35	345
9	.02	346
10	hit the	bottom
AVERAGE		

South Duct

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
B-1	.32	190
2	.50	315
3	.54	326
4	.62	331
5	.69	333
6	.76	334
7	1.00	335
8	.93	337
9	.85	341
10	.81	340
11	.56	337
Out of Stack (hit the wall		
B-1	.42	242
2	.55	312
3	.61	325
4	.60	329
5	.61	332
6	.65	335
7	.85	336
8	.77	336
9	.69	336
10	.60	335
11	.36	333
AVERAGE		

Other Duct
North Duct

→ STATIC − 4.1

EPA (Dur) 233
4 72

Figure B-1. Preliminary velocity traverse.

RADIAN
CORPORATION

EPA METHODS 1-4, 5

NOMOGRAPH DATA

PLANT BLB-B

DATE 2/26/85

SAMPLING LOCATION Inlet

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE. in. H_2O	$\Delta H_@$	1.90
AVERAGE METER TEMPERATURE (AMBIENT + 20 °F). °F	$T_{m\,avg.}$	90°
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	30 / 25
BAROMETRIC PRESSURE AT METER. in. Hg	P_m	30.22
STATIC PRESSURE IN STACK. in. Hg −4.5" H_2O (P_m ± 0.073 x STACK GAUGE PRESSURE in in. H_2O)	P_s	29.89
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	0.989
AVERAGE STACK TEMPERATURE. °F	$T_{s\,avg.}$	335
AVERAGE VELOCITY HEAD. in. H_2O	$\Delta p_{avg.}$	0.65
MAXIMUM VELOCITY HEAD. in. H_2O	$\Delta p_{max.}$	1.00
C FACTOR	.66 / 0.71	
CALCULATED NOZZLE DIAMETER. in.	1/4	
ACTUAL NOZZLE DIAMETER. in.	0.242	
REFERENCE Δp. in. H_2O	1.1 / 1.05	

EPA (Dur) 234
4 72

Figure B-2. Nomograph data.

~~05NELI~~N 1
05VELNI1

PRELIMINARY VELOCITY TRAVERSE

PLANT BPP -
DATE 2/26/85
LOCATION ESP Inlet
STACK I.D. [illegible] Duct
BAROMETRIC PRESSURE, in Hg
STACK GAUGE PRESSURE, in. H_2O -3.8
OPERATORS flg, gdh, web

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
12	.41	339
11	.57	331
10	.63	330
9	.70	333
8	.86	336
7	.82	335
6	.61	335
5	.55	334
4	.58	334
3	.53	333
2	.21	331
1	.56	176
AVERAGE		

EPA (Dur) 233
4 72

SCHEMATIC OF TRAVERSE POINT LAYOUT

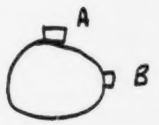
TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

Figure B-1. Preliminary velocity traverse.

PRELIMINARY VELOCITY TRAVERSE

FILENAME
05VELN2.PX

PLANT Site 05
DATE 2/27/85 1130 hrs
LOCATION INLET NORTH DUCT
STACK I.D. 89.5"
BAROMETRIC PRESSURE, in. Hg 30.20
STACK GAUGE PRESSURE, in. H_2O -4.5" H_2O
OPERATORS WCK



SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
B 1	0.52	325
2	0.57	332
3	0.57	337
4	0.55	339
5	0.54	339
6	0.74	339
7	0.78	339
8	0.85	339
9	0.77	339
10	0.72	339
11	0.59	340
12	0.53	338
A 1	0.59	325 Assumed
2	0.67	323
3	0.77	340
4	0.79	326
5	0.83	332
6	0.81	337
7	0.70	338
8	0.61	~~277~~ 330 Assumed bad reading
9	0.56	320
10	0.51	334
11	0.44	334
12	hit bottom (accumulation)	
AVERAGE		

EPA (Dur) 233
4/72

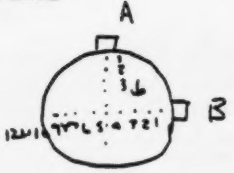
TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
A		
AVERAGE		

Figure B-1. Preliminary velocity traverse.

PRELIMINARY VELOCITY TRAVERSE

05 VELN3

PLANT Site 05
DATE 2/28/85 1000hrs
LOCATION INLET NORTH DUCT
STACK I.D. 89½"
BAROMETRIC PRESSURE, in. Hg
STACK GAUGE PRESSURE, in. H_2O – 4.5" Hg
OPERATORS WK/JM



SCHEMATIC OF TRAVERSE POINT LAYOUT

.018

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
A-1	0.40	208
2	0.67	226
3	0.80	297
4	0.88	327
5	0.91	332
6	0.81	334
7	0.66	331
8	0.53	330
9	0.50	329
10	0.38	324
11	–	–
12	–	–
B 1	0.40	270 Pt ASSUMED)
2	0.60	270
3	0.67	280
4	0.65	315
5	0.66	323
6	0.70	327
7	0.79	327
8	0.85	333
9	0.74	338
10	0.60	338
11	0.58	340
12	0.46	340
AVERAGE		

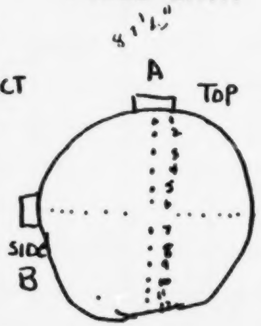
TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
AVERAGE		

EPA (Dur) 233
4 72

Figure B-1. Preliminary velocity traverse.

FIELD DATA

PLANT BLB-B
DATE 2/25 26/85
SAMPLING LOCATION INLET / SOUTH DUCT
SAMPLE TYPE MHS
RUN NUMBER 1
OPERATOR WEK / JRK
AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 30.22
STATIC PRESSURE (P_s) -4.5" H_2O
FILTER NUMBER (s) MHS INLET
MINIMUM SAMPLE VOLUME



PROBE LENGTH AND TYPE 10' glass
NOZZLE I.D. 0.242
ASSUMED MOISTURE, % ~~30~~ 25
SAMPLE BOX NUMBER 5B (INLET)
METER BOX NUMBER 9E
METER Δ H@ 1.90
C FACTOR ~~0.66~~ 0.71
PROBE HEATER SETTING 60%
HEATER BOX SETTING variable
REFERENCE Δp ~~1.1~~ 1.05
DRY/GAS METER FACTOR (Y) 1.0097

Started bag sample
1505 hrs
Stopped 1605 hrs

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY ~~10~~ 5 MINUTES

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F 2	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Orifice Pressure Differential (ΔH, in. H_2O) Actual	Temperature [✓ °F]/°C (Circle One) Probe 1	Filter Skin 4	Filter Out	Recirc. Water	Absorbent Trap 3	Dry Gas Meter Inlet (T_m in) 6	Dry Gas Meter Outlet (T_m out) 7	Impinger Exit 5	Pump Vacuum in. Hg
[illegible]			~~[illegible]~~													
B-1	~~1452~~ 0	1452	737.665	0.25	253	0.45	0.45	~~250~~	258			69	90	91	81	4
	5	1457 ~~1458~~	739.610	0.21	264	0.42	0.42	~~259~~	241			70	90	93	79	5
B-2	10	1502 ~~1508~~	741.43	0.40	325	0.72	0.72		257			65	90	97	76	6.5
	15	1507 ~~1513~~	743.610	0.37	331	0.66	0.66		231			53	91	103	74	8
B-3	20	1512 ~~1518~~	745.81	0.47	339	0.85	0.85		238		ice bath	60	92	106	76	10
	25	1517	748.24	0.47	334	0.85	0.85		243			63	93	112	74	11
B-4	30	1522	750.72	0.52	335	0.93	0.93		223			60	96	114	67	14
	35	1527	753.27	0.51	334	0.90	0.90		248			60	97	118	66	15
B-5	40	1532	755.80	0.69	338	1.22	1.22		221			61	99	119	65	21
	45	1537	758.73	0.65	337	1.18	1.10		248			62	100	117	67	25
filter change	50	1542	761.347	leak check		0.015 cfm @			24" Hg							
		leak check -		0.011 cfm@		15" Hg										
B-6	~~55~~ 50	1614	761.658	0.64	330	1.12	1.12		253			63	97	97	72	10
	~~60~~ 55	1619	764.80	0.64	333	1.12	1.12		219			62	97	104	65	11

COMMENTS: pretest T/c check
2 68
3 69
4 70
5 72

pretest port B leak ck - 0.013 cfm @ 15" Hg - pitot leak check OK

Site 05

Continuation - p-2

Inlet RUN 1

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s in °F	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Orifice Pressure Differential (ΔH, in. H_2O) Actual	Temperature °F/°C (Circle One) [✓ °F] Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
B-6	60	1624	767.15	0.64	335	1.12	1.12		241			61	97	107	64	11
B-7	65	1629	770.00	0.73	331	1.30	1.30		250			60	97	109	64	14
B-7	70	1634	772.92	0.76	333	1.35	1.35		226		ice bath	60	96	114	66	18
B-8	75	1639	775.60	0.80	335	1.40	1.40		256			61	98	116	68	25
B-8	80	1644	778.046	0.84	338	1.48	1.10		233			60	98	115	70	
	change	filter	: leak check =		0.016	cfm @	25" Hg									
~~[illegible]~~	leak	check	: 0.012	cfm @	15" Hg											
restart	80	1730 ~~[illegible]~~	779.01	—												
B-9	85	1735	782.61	0.93	345	1.67	1.67		282			63	86	87	65	12
B-9	90	1740	785.66	0.87	344	1.55	1.55		239			63	86	94	60	14
B-10	95	1745	788.68	0.80	342	1.40	1.40		248			61	86	100	61	16
B-10	100	1750 ~~1800~~	791.63	0.76	344	1.37	1.37		248			60	86	100	63	22
B-11	105	1755 ~~1805~~	794.47	0.72	342	1.30	1.30		267			60	87	99	66	24
B-11	110	1800 ~~1810~~	797.08	0.75	343	1.35	1.10		257			59	87	96	67	25
B-12	115	1805 ~~1815~~	799.62	0.64	341	1.15	0.92		286			58	86	93	66	25
B-12	120	1810 ~~1820~~	802.730	0.64	341	1.15	1.15		241			63	86	95	65	20
	stop -	port	change / change	filter	-	leak	check		0	at	27" Hg					
TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
AVERAGE	●	●	●	●		●		●	●	●	●	●			●	●

← flow increased about 1806

vacuum dropped from 25 to 20" Hg @ 1806. Got more sample flow. Sample stream after filter looked a little

MODIFIED METHOD 5 DATA

Continuation . p. 3

PROBED TOP
PORT WITH
~~[illegible]~~ SOUNDING
STICK. FOUND
BOTTOM @ ~~[illegible]~~ $83\frac{1}{2}$"
from Top of flange
POINT 9 is at $79\frac{5}{8}$"
10 is at 85"

PLANT BLB-B
DATE 2/26/85
SAMPLING LOCATION INLET SOUTH DUCT
SAMPLE TYPE MM5
RUN NUMBER 1
OPERATOR WEK / JRMC
AMBIENT TEMPERATURE
BAROMETRIC PRESSURE
STATIC PRESSURE (P_s)
FILTER NUMBER (s)
MINIMUM SAMPLE VOLUME
INITIAL LEAK CHECK 0 @ 15cfm

PROBE LENGTH AND TYPE
NOZZLE I.D.
ASSUMED MOISTURE, %
SAMPLE BOX NUMBER
METER BOX NUMBER
METER Δ H@
C FACTOR
PROBE HEATER SETTING
HEATER BOX SETTING
REFERENCE Δp
DRY/GAS METER FACTOR (Y)
FINAL LEAK CHECK

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F 2	Orifice Pressure Differential (ΔH, in. H_2O)		Temperature (°F) / °C (Circle One) [✓ °F]								Pump Vacuum in. Hg
						Desired	Actual	Probe	Filter Skin 4	Filter Out	Recirc. Water	Absorbent Trap 3	Dry Gas Meter Inlet (T_m in) 1	Dry Gas Meter Outlet (T_m out) 7	Impinger Exit 5	
		2003	803.410													
A-1	125	2008	805.29	0.45	139	0.80	0.80		252			59	70	71	58	7
A-1	130	2013	807.25	0.31	125	0.55	0.55		219			59	71	76	55	6
A-2	135	2018	809.58	0.49	324	0.87	0.87		254		ice bath	60	71	81	54	10
A-2	140	2023	812.03	0.50	329	0.89	0.89		221			61	72	87	55	11
A-3	145	2028	814.71	0.60	329	1.08	1.08		256			61	73	91	55	14
A-3	150	2033	817.30	0.60	329	1.08	1.08		227			63	74	94	56	18
A-4	155	2038	819.82	0.61	330	1.10	1.10		252			63	75	94	58	20
A-4	160	2043	822.313	0.57	325	1.00	1.00		236			63	76	95	59	22

change filter - leak check = X support cable broke while lifting box out of duct.
probe definately broken. leak checked sample box from filter back.
0 cfm @ 22" Hg

COMMENTS

6
① start bag : 1235
~~[illegible]~~ stop : 1410

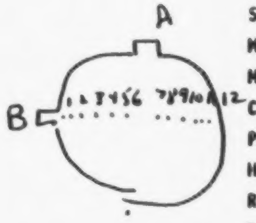
¼ ③ start ~~1425~~ 1605
stop 1620

bag 3 start 1800
stop

FIELD DATA

PLANT Site 05
DATE 2/27/85
SAMPLING LOCATION INLET/SOUTH DUCT
SAMPLE TYPE MM-5
RUN NUMBER 2
OPERATOR WSK / JRM / CAT
AMBIENT TEMPERATURE 70
BAROMETRIC PRESSURE 30.20
STATIC PRESSURE (P_s) -4.5" H_2O
FILTER NUMBER (s) inlet Run 2.
MINIMUM SAMPLE VOLUME 90

MM5



PROBE LENGTH AND TYPE 10' glass
NOZZLE I.D. 0.242
ASSUMED MOISTURE, % 30
SAMPLE BOX NUMBER ~~9E~~
METER BOX NUMBER 9E
METER Δ H@ 1.90
C FACTOR ~~1.0097~~ 0.66
PROBE HEATER SETTING 60
HEATER BOX SETTING variable
REFERENCE Δp 1.1
DRY/GAS METER FACTOR (Y) 1.0097

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Orifice Pressure Differential (ΔH, in. H_2O)		Temperature [✓ °F] °C (Circle One)								Pump Vacuum in. Hg
						Desired	Actual	Probe	Filter		Recirc. Water	Absorbent Trap	Dry Gas Meter		Impinger Exit	
									Skin	Out			Inlet (T_m in)	Outlet (T_m out)		
START		1230	823.342													
B-1	5	1235	825.35	0.32	344*	0.54	0.54		242			63	72	74	68	3
B-1	10	1240	827.33	0.34	299	0.58	0.58		219 180			63	72	79	64	5
B-2	15	1245	829.60	0.44	326	0.79	0.79		247			62	73	85	60	6
B-2	20	1250	831.97	0.48	337	0.83	0.83		226		ice bath	63	83	91	60	9
B-3	25	1255	834.41	0.52	339	0.89	0.89		235			64	77	97	60	10
B-3	30	1300	836.40	0.53	338	0.91	0.91		233			65	78	101	60	11
B-4	35	1305	839.44	0.53	338	0.91	0.91		215			64	79	105	59	13
B-4	40	1310	841.89	0.56	339	0.95	0.95		238			65	82	108	60	15
B-5	45	1315	844.50	0.61	339	1.02	1.02		218			66	84	109	61	18
B-5	50	1320	847.012	0.61	340	1.02	1.02		242			65	84	108	62	21
		stop to change filters			leak check : 0.015 cfm @ 21" Hg											
		~~[illegible]~~														

COMMENTS pretest leak check - ~~0~~ 0.008 @ 15" Hg

* ASSUMED [illegible]

page 1 of 4

Site 05 Inlet - Run 2 (con't) p. 2/4

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Orifice Pressure Differential (ΔH, in. H_2O) Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
leak check : 0.018 @ 16" Hg																
restart	50	1335	847.435													
B-6	55	1340	849.99	0.70	339	1.08	1.08		245			62	84	96	65	5
8-6	60	1345	852.73	0.73	338	1.11	1.11		212			64	86	103	61	7.5
B7	65	1350	855.72	0.82	333	1.38	1.38		246			65	86	110	60	11
B7	70	1355	858.78	0.82	336	1.38	1.38		215		ice bath	64	88	116	61	15
B8	75	1400	861.85	0.84	329	1.42	1.42		246			65	90	119	66	18
B8	80	1405	864.827	0.84	333	1.42	1.42		221			66	93	121	69	22
		stop - change filter - leak check: 0.014 cfm @ 22" Hg														
	leak check : 0.019 cfm @ 16" Hg															
restart	80	1422	865.840													
B9	85	1427	868.83	0.80	335	1.35	1.35		218			65	~~70~~ 93	~~93~~ 107	70	7
B9	90	1432	871.87	0.84	337	1.41	1.41		214			67	93	112	68	9
B10	95	1437	874.83	0.78	336	1.31	1.31		234			66	93	115	69	11
B10	100	1442	877.87	0.84	336	1.41	1.41		230			68	92	118	71	20
B11	105	1447	880.73	0.67	333	1.15	1.15		238			68	93	117	73	17
B11	·110	1452	883.433	0.67	332	1.15	1.15		222			65	93	117	75	18
		stop & empty condensate impinger leak check : 0.026 @ 21" Hg														
		leak check : 0.018 cfm @ 16" Hg														
restart	110	1501	883.862													
B12	115	1506	886.36	0.59	331	1.00	1.00		253			68	91	104	74	20
B12	120	1511	888.832	0.56	332	0.95	0.95		229			68	92	106	74	
	end port B. leak check :															
TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
AVERAGE	●	●	●	●		●		●	●	●		●			●	●

2/27/85
Site 05

leak check : 0.016 cfm@ 15" Hg

Inlet Run 2 cont page 3/4

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Orifice Pressure Differential (ΔH, in. H_2O)		Temperature [✓ °F] °C (Circle One)								Pump Vacuum in. Hg
						Desired	Actual	Probe	Filter		Recirc. Water	Absorbent Trap	Dry Gas Meter		Impinger Exit	
									Skin	Out			Inlet (T_m in)	Outlet (T_m out)		
restart	120	1600	889.224													
A-1	125	1605	891.06	0.30	305	0.51	0.51		229			63	81	83	-	3
A-1	130	1610	892.716	0.24	267	0.41	0.41		244			67	81	85	-	3
~~A-2~~	Train dropped while changing points @ almost exactly 130 minutes. stopped.															
		leak check - 0.016 cfm@ 15" Hg. no														
		found black liquid material														
		Took probe off to inspect.; see if had fit contamination at bottom of port none apparent.														
		leak check - 0.012 cfm@ 15" Hg														
restart	130	1753	893.103								ice bath					
A-2	135	1758	896.01	0.63	326	1.08	1.08		245			60	79	80	-	6
A-2	140	1803	898.41	0.70	328	1.20	1.20		259			61	80	90	-	8
A-3	145	1808	900.10	0.70	326	1.20	1.20		230			61	81	98	-	10
A-3	150	1813	-	0.65	325	1.10	1.10		248			62	83	106	-	12
A-4	155	1818	906.57	0.73	323	1.22	1.22		227			62	85	110	-	15
A-4	160	1823	909.475	0.75	324	1.30	1.30		246			63	86	112	-	17
		stop change filter leak check : 0.010 cfm @ 20" Hg														
~~restart~~		leak check : ~~0.02~~ 0.012 cfm@ 15" Hg														
restart	160	1845	909.845													
A-5	165	1850	912.59	0.71	328	1.20	1.20		233			60	86	96	-	5
A-5	170	1855	915.45	0.71	332	1.20	1.20		245			63	86	102	-	8
A-6	175	1900	918.14	0.73	332	1.22	1.22		223			62	87	107	-	10
A-6	180	1905	920.89	0.72	332	1.21	1.21		245			62	87	108	-	11
TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
AVERAGE	●	●	●	●		●		●	●	●	●	●			●	●

Site 5 Inlet Run 2 2/27/85 continuation ~~Continuation~~ page 4/4

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Oriface Pressure Differential (ΔH, in. H_2O)		Temperature [✓ °F] °C (Circle One)								
						Desired	Actual	Probe	Filter		Recirc. Water	Absorbent Trap	Dry Gas Meter		Impinger Exit	Pump Vacuum in. Hg
									Skin	Out			Inlet (T_m in)	Outlet (T_m out)		
A-7	185	1910	923 ~~933~~.83	0.74	341	1.25	1.25		215			63	88	111	–	14
A-7	190	1915	926.49	0.71	340	1.20	1.20		239			62	88	111	–	15
A-8	195	1920	928.81	0.45	344	0.76	0.76		220			62	88	110	–	15
A-8	200	1925	931.066	0.46	343	0.70	0.70		229			61	88	110	–	14
		stopped		at pt. 8 to	stay	away	from		surface		of	accumulation				
		@	83½"													
		leak	check:	0.012	cfm	@ 16" Hg										
TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
AVERAGE	●	●	●	●		●		●	●	●	●	●			●	●

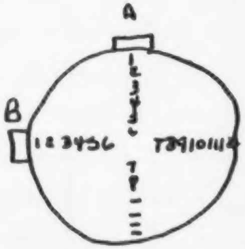
4"

Start bag 1345
Stop 1500

Start bag 2 1505

FIELD DATA

PLANT Site 05
DATE 2/28/85
SAMPLING LOCATION INLET / SOUTH DUCT
SAMPLE TYPE MMS
RUN NUMBER 3
OPERATOR WEK / JRMK / CAS
AMBIENT TEMPERATURE 65
BAROMETRIC PRESSURE 30.24
STATIC PRESSURE (P_s) -4.5" H_2O
FILTER NUMBER (s) inlet
MINIMUM SAMPLE VOLUME 90



PROBE LENGTH AND TYPE 10' GLASS
NOZZLE I.D. 0.242
ASSUMED MOISTURE, % 30
SAMPLE BOX NUMBER INLET
METER BOX NUMBER 9E
METER Δ H@ 1.90
C FACTOR 0.67
PROBE HEATER SETTING 60
HEATER BOX SETTING 140
REFERENCE Δp 1.10
DRY/GAS METER FACTOR (Y) 1.0097

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY 5 MINUTES

pretest leak check 0.015 cfm @ 16" Hg

page 1 of 3

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Oriface Pressure Differential (ΔH, in. H_2O)		Temperature [✓ °F] °C (Circle One)								Pump Vacuum in. Hg
						Desired	Actual	Probe	Filter		Recirc. Water	Absorbent Trap	Dry Gas Meter		Impinger Exit	
									Skin	Out			Inlet (T_m in)	Outlet (T_m out)		
Start	0	1055	933.295													
A-1	5	1100	935.29	0.38	320	0.64	0.64		284		ice bath	57	~~73~~ 66	67	64	2
A-1	10	1105	937.32	0.35	329	0.59	0.59		253			58	66	70	63	3
A-2	15	1110	939.54	0.65	334	1.08	1.08		272			57	67	80	58	6
A-2	20	1115	942.24	0.68	335	1.18	1.18		245			56	68	84	59	8
A-3	25	1120	944.99	0.71	334	1.20	1.20		259			~~63~~ 58	70	92	59	10
A-3	30	1125	947.78	0.71	335	1.20	1.20		256			57	72	96	59	12
A-4	35	1130	950.69	0.76	336	1.30	1.30		243			58	74	102	58	16
A-4	40	1135	954.167	0.78	339	1.32	1.32		256			58	76	105	58	20
		stop - change	filter:		leak check -							~~56~~				
		leak	check:	0.010	cfm @	16" Hg										
restart	40	1155	954.843													
A-5	45	1200	957.52	0.61	334	1.04	1.04		239			56	80	90	61	3
A-5	50	1205	—	0.76	334	1.30	1.30		244			59	80	97	57	14
A-6	55	1210	962.592	0.74	334	1.28	.90		208			57	81	98	58	25

COMMENTS Stop - check filter & nozzle - leak check 0.011 @ 26" Hg
Changed filter - rinsed nozzle w/ Water

Site 05 Inlet Run 3 continuation p 2 of 3

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, °F 2	Orifice Pressure Differential (ΔH, in. H_2O)		Temperature [✓ °F] °C (Circle One)								
						Desired	Actual	Probe	Filter Skin 4	Filter Out	Recirc. Water	Absorbent Trap 3	Dry Gas Meter Inlet (T_m in) 6	Dry Gas Meter Outlet (T_m out) 7	Impinger Exit 5	Pump Vacuum in. Hg
	leak	check	: 0.019	cfm @	16" Hg											
restart	55	1230	963.025													
A-6	60	1235	965.89	0.76	332	1.30	1.30		220		ice bath	58	84	98	64	5
A-7	65	1240	968.81	0.80	341	1.35	1.35		230			55	85	106	59	13
A-7	70	1245	971.48	0.70	337	1.18	1.18		238			56	86	109	60	16
A-8	75	1250	973.91	0.48	341	0.81	0.81		217			56	87	110	65	18
A-8	80	1255	976.051	0.43	340	0.73	0.73		254			56	87	116	66	18
		stop change ports	/ change filter -				leak check: 0.012 @ 19" Hg									
		leak	check :	0.010 @	16"	Hg										
restart	80	1333	976.380													
B-1	85	1338	978.37	0.32	335	.54	.54		283			58	83	90	62	3
B-1	90	1343	980.28	0.32	335	0.54	0.54		263			60	84	92	61	3
B-2	95	1348	982.49	0.43	337	0.73	0.73		223			61	86	99	61	4
B-2	100	1353	984.83	0.47	337	0.80	0.80		266			59	88	104	61	6
B-3	105	1358	987.23	0.50	339	0.85	0.85		227			66	90	109	64	8
B-3	110	1403	989.61	0.49	337	0.83	0.83		278			61	92	112	64	9
B-4	115	1408	992.00	0.54	336	0.92	0.92		285			~~59~~ 59	93	115	65	10
B-4	120	1413	994.52	0.54	337	0.92	0.92		266			58	94	115	65	12
B-5	125	1418	997.10	0.58	334	0.99	0.99		247			59	94	118	66	14
B-5	130	1423	999.71	0.58	335	0.99	0.99		286			61	95	118	68	16
B-6	135	1428	1002.47	0.72	336	1.20	1.20		254			61	96	118	71	21
B-6	140	1433	1005.206	0.75	337	1.27	1.27		238			62	96	116	73	24
	stop	- change filters :		leak check:		0.075 cfm	@ 26" Hg									
TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
AVERAGE	●	●	●	●				●	●	●	●	●			●	●

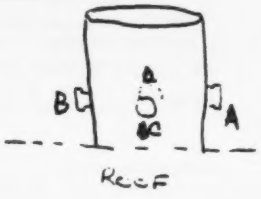
Site 05 Inlet Run #3 continuation p 3 of 3

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, °F 2	Orifice Pressure Differential (ΔH, in. H_2O)		Temperature [✓ °F]/°C (Circle One)								Pump Vacuum in. Hg
									Filter				Dry Gas Meter			
						Desired	Actual	Probe	Skin 4	Out	Recirc. Water	Absorbent Trap 3	Inlet (T_m in) 6	Outlet (T_m out) 7	Impinger Exit 5	
	leak check = 0.012 cfm @ 16" Hg															
restart	140	1503	1007.734													
B-7	145	1508	1010.73	0.76	335	1.30	1.30		243			60	95	105	68	4
B-7	150	1513	1013.66	0.76	335	1.30	1.30		225		ice bath	66	95	111	65	6
B-8	155	1518	1016.60	0.79	338	1.35	1.35		213			59	95	114	67	8
B-8	160	1523	1019.62	0.80	335	1.36	1.36		235			60	95	116	68	11
B-9	165	1528	1022.64	0.79	336	1.35	1.35		214			64	96	118	70	13
B-9	170	1533	1025.64	0.78	334	1.32	1.32		242			62	95	118	71	15
B-10	175	1538	–	0.82	337	1.38	1.38		225			61	95	118	72	20
B-10	180	1543	1031.708	0.77	337	1.30	1.30		247			62	94	116	73	23
	stop - change filter - leak check: 0.018 cfm @ 23" Hg															
	leak check: ~~0.010 cfm @ 23"~~ Hg 0.005 cfm @ 16" Hg															
restart	180	1555	1039.852													
B-11	185	1600	1042.71	0.71	336	1.20	1.20		246			57	95	116	69	3
B-11	190	1605	1045.46	0.71	338	1.20	1.20		226			57	95	116	67	5
B-12	195	1610	1047.99	0.59	333	1.00	1.00		237 208			56	94	114	66	7
B-12	200	1615	1050.900	0.54	330	0.92	0.92		242			57	93	112	66	8
			end test leak check: 0.005 @ 10" Hg													
TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
AVERAGE	●	●	●	●		●		●	●	●	●	●			●	●

EPA METHOD 1

TRAVERSE POINT LOCATION FOR CIRCULAR DUCTS

PLANT
DATE 2-25-85
SAMPLING LOCATION Outlet - MM5
INSIDE OF FAR WALL TO OUTSIDE OF NIPPLE. (DISTANCE A)
INSIDE OF NEAR WALL TO OUTSIDE OF NIPPLE. (DISTANCE B) 3 1/2 inches
STACK I.D., (DISTANCE A - DISTANCE B) 12 ft
NEAREST UPSTREAM DISTURBANCE
NEAREST DOWNSTREAM DISTURBANCE
CALCULATOR CLJ

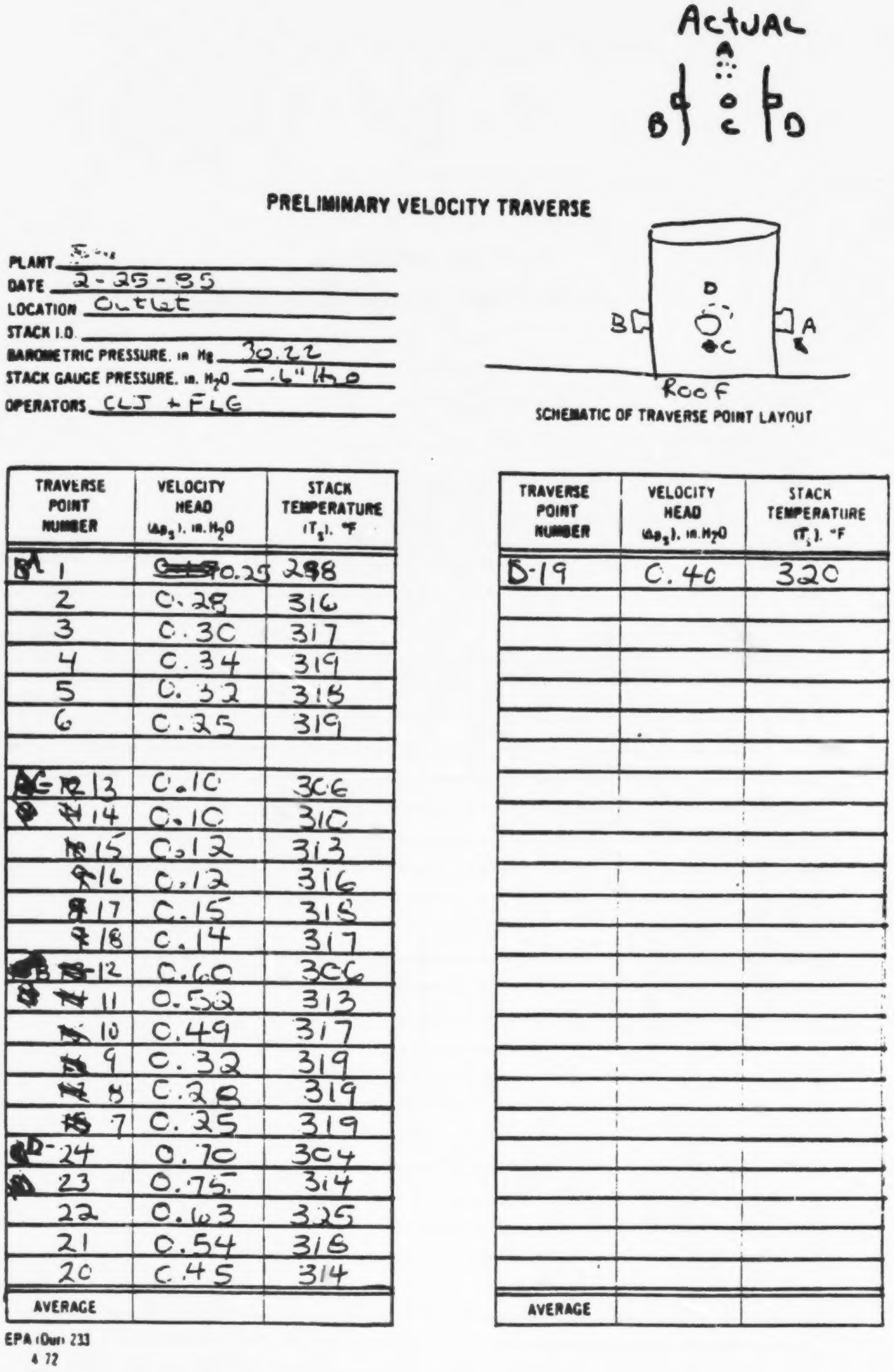


SCHEMATIC OF SAMPLING LOCATION

TRAVERSE POINT NUMBER	FRACTION OF STACK I.D.	in STACK I.D.	PRODUCT OF COLUMNS 2 AND 3 (TO NEAREST 1/8 INCH) in	DISTANCE B in	TRAVERSE POINT LOCATION FROM OUTSIDE OF NIPPLE (SUM OF COLUMNS 4 & 5)
1	0.021	~~12~~144	3.024	3.5	6 1/2 inches
2	0.067	144	9.648	"	13 1/8
3	0.118	144	16.992	"	20 1/2
4	0.177	"	25.488	"	29
5	0.250	"	36.000	"	39 1/2
6	0.356	"	51.264	"	54 3/4
7	0.644				
8	0.750				
9	0.823				
10	0.882				
11	0.933				
12	0.979				

EPA (Dur) 232
4/72

Figure B-3. Traverse point location for circular ducts.


Actual
A
B
C
D
D
B
A
C
Roof

PRELIMINARY VELOCITY TRAVERSE

PLANT [illegible]
DATE 2-25-85
LOCATION Outlet
STACK I.D.
BAROMETRIC PRESSURE, in Hg 30.22
STACK GAUGE PRESSURE, in. H_2O -.6" H_2O
OPERATORS CLJ + FLG

SCHEMATIC OF TRAVERSE POINT LAYOUT

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
A 1	~~0.15~~ 0.25	288
2	0.28	316
3	0.30	317
4	0.34	319
5	0.32	318
6	0.25	319
C-~~12~~ 13	0.10	306
14	0.10	310
15	0.12	313
16	0.12	316
17	0.15	318
18	0.14	317
B-12	0.60	306
11	0.52	313
10	0.49	317
9	0.32	319
8	0.28	319
7	0.25	319
D-24	0.70	304
23	0.75	314
22	0.63	325
21	0.54	318
20	0.45	314
AVERAGE		

TRAVERSE POINT NUMBER	VELOCITY HEAD (Δp_s), in. H_2O	STACK TEMPERATURE (T_s), °F
D-19	0.40	320
AVERAGE		

EPA (Dur) 233
4 72

Figure I-1. Preliminary velocity traverse.

RADIAN
CORPORATION

EPA METHODS 1-4, 5

NOMOGRAPH DATA

PLANT SITE 05

DATE FEB. 26, 1985

SAMPLING LOCATION STACK OUTLET - MM5

CALIBRATED PRESSURE DIFFERENTIAL ACROSS ORIFICE, in. H_2O	$\Delta H_@$	1.79
AVERAGE METER TEMPERATURE (AMBIENT + 20°F), °F	$T_{m_{avg.}}$	908~~5~~°F
PERCENT MOISTURE IN GAS STREAM BY VOLUME	B_{wo}	~~30~~ 25 %
BAROMETRIC PRESSURE AT METER, in. Hg	P_m	30.22
STATIC PRESSURE IN STACK, in. Hg ($P_m \pm 0.073$ x STACK GAUGE PRESSURE in in. H_2O)	P_s	-.6" H_2O
RATIO OF STATIC PRESSURE TO METER PRESSURE	P_s/P_m	1.0
AVERAGE STACK TEMPERATURE, °F	$T_{s_{avg.}}$	315.F
AVERAGE VELOCITY HEAD, in. H_2O	$\Delta p_{avg.}$	.34
MAXIMUM VELOCITY HEAD, in. H_2O	$\Delta p_{max.}$	.75
C FACTOR	0.70	
CALCULATED NOZZLE DIAMETER, in.	1/4	
ACTUAL NOZZLE DIAMETER, in.	[illegible]	
REFERENCE Δp, in. H_2O	[illegible] .95	

1/4

0.250

EPA (Dur) 234
4 72

Figure I-2. Nomograph data.

Site 05

FIELD DATA

PLANT [redacted] [redacted]
DATE 2-26-85
SAMPLING LOCATION Outlet
SAMPLE TYPE MM5
RUN NUMBER MM5-01-Outlet
OPERATOR HENRY, GARCIA
AMBIENT TEMPERATURE 83°F
BAROMETRIC PRESSURE 30.22
STATIC PRESSURE (P_s) -.6" H_2O
FILTER NUMBER (s) N/A
MINIMUM SAMPLE VOLUME 120 ft³

PROBE LENGTH AND TYPE 5' GLASS
NOZZLE I.D. 0.250 inches
ASSUMED MOISTURE, % 33
SAMPLE BOX NUMBER
METER BOX NUMBER 4
METER Δ H@ 1.78
C FACTOR 0.70
PROBE HEATER SETTING
HEATER BOX SETTING 250°F
REFERENCE Δp 0.95
DRY/GAS METER FACTOR (Y) 1.0092

LEAK CHECKS

	PRE	POST
A	.010	.013
B	.010	.005
C	.005	.012
D	.011	.012

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

	Traverse Point Number	0 Sampling Time Min.	1415 Clock Time (24-hr Clock)	668.475 Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Orifice Pressure Differential (ΔH, in. H_2O) Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
STOP	A-1	7	22	671.983	.88	316	.50	.50	N/A	246	—	—	60	100	92	62	4
		7	1446	671.585	←	Oxygen		PROBLEM									→
START	A-1	10	49	672.525	.15	318	.28	.28	N/A	250	—	—	60	101	92	63	5
	A-2	16	54	674.325	.45	322	.85	.85	N/A	243	—	—	58	103	92	63	5.5
	A-2	20	59	676.265	.23	321	.43	.43	N/A	241	—	—	59	104	93	64	5
	A-3	25	1504	678.45	.45	323	.85	.85	N/A	243	-	—	59	104	93	67	6
	A-3	30	09	680.81	.85	322	1.6	1.6	N/A	246	-	—	57	107	93	68	7
	* A-4	35	14	683.92	.80	322	1.5	1.5	N/A	246	-	—	57	114	95	74	7
		40	19	686.38	.37	320	.70	.70	N/A	249	—	—	60	114	96	75	5
	A-5	45	24	689.01	.63	335	1.2	1.2	N/A	246	—	—	76	114	97	92	7
		50	29	691.50	.48	320	.89	.89	N/A	256	-	—	61	110	97	79	7
	A-6	55	34	694.10	.50	321	.93	.93	N/A	259	-	—	67	107	94	67	6
STOP		60	39	696.848	.28	320	.50	.30	N/A	262	—	—	61	103	93	68	5
START		60	1607	696.389	—	CHANGED		PORT		—							—
	B-1	65	12	698.77	.37	298	.69	.69	N/A	236	—	—	66	89	84	71	5

COMMENTS Initial Leakrate @ 15 in Hg = [illegible] 0.015 ft³/min

* NOISE IN STACK OCCURRED

1 of 2

rt 2nd Bag 1750
Final Bag 1843

LEAK CHECKS

	PRE	POST
A	.010	.013
B	.010	.005
C	.005	.012
D	.011	

	Traverse Point Number	65 Sampling Time Min.	1612 Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Oriface Pressure Differential (ΔH, in. H_2O) Desired	Oriface Pressure Differential (ΔH, in. H_2O) Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet ($T_{m\ in}$)	Dry Gas Meter Outlet ($T_{m\ out}$)	Impinger Exit	Pump Vacuum in. Hg
	B-1	70	1617	700.62	.37	302	.70	.70	N/A	228	–	–	60	96	85	72	5
	B-2	75	22	703.08	.55	314	1.05	1.05	N/A	231	–	–	60	98	85	75	6
		80	27	705.76	.50	315	.94	.94	N/A	232	–	–	61	98	85	76	6
	B-3	85	32	708.16	.60	316	1.15	1.15	N/A	233	–	–	59	97	84	68	6
		90	37	710.79	.60	316	1.15	1.16	N/A	240	–	–	60	98	84	66	6
	B-4	95	42	713.33	.52	318	.98	.98	N/A	241	–	–	62	99	84	69	6
1644 * 10 sec		100	47	715.73	.50	318	.94	.94	N/A	249	–	–	63	99	84	69	6
	B-5	105	52	718.045	.45	319	.85	.85	N/A	252	–	–	53	98	83	72	6
		110	57	720.34	.45	320	.85	.85	N/A	256	–	–	76	98	83	74	6
	B-6	115	1702	722.82	.30	320	.57	.57	N/A	256	–	–	58	95	83	73	5
STOP		120	05	723.789	.32	320	.59	.59	N/A	263	–	–	56	93	82	69	5
START		120	1744	724.258	← CHANGED TO PORT Ⓒ →												
	C-1	125	52	725.785	.15	251	.28	.28	–	238	–	–	66	80	77	61	4
		130	57	727.25	.14	303	.26	.26	–	230	–	–	59	83	77	59	4
	C-2	135	1802	728.710	.17	319	.34	.34	–	231	–	–	63	83	76	60	4
		140	07	730.11	.17	319	.34	.34	–	229	–	–	59	82	76	59	4
1810 * 15 sec	C-3	145	12	731.505	.20	320	.37	.37	–	228	–	–	61	82	75	60	4
		150	17	733.08	.18	320	.345	.345	–	223	–	–	59	81	75	60	4
	C-4	155	22	734.295	.21	321	.38	.38	–	226	–	–	59	80	74	61	4
		160	27	735.73	.19	321	.35	.35	–	229	–	–	60	80	73	62	4
	C-5	165	32	737.125	.20	320	.37	.37	–	230	–	–	61	80	73	64	4
		170	37	738.54	.20	321	.37	.37	–	232	–	–	60	80	73	65	4
	C-6	175	42	739.81	.22	323	.40	.40	–	237	–	–	60	80	73	66	4
1644 * 15 sec		180	47	741.397	.22	322	.40	.40	–	243	–	–	60	81	73	67	5
	TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
	AVERAGE	●	●	●	●		●		●	●	●	●	●			●	●

* [illegible] STACK

MODIFIED METHOD 5 DATA

PLANT Site 05
DATE 2-26-85
SAMPLING LOCATION Outlet
SAMPLE TYPE MM5
RUN NUMBER MM5-01-Outlet
OPERATOR Henry, Garcia
AMBIENT TEMPERATURE 50°F
BAROMETRIC PRESSURE 30.22
STATIC PRESSURE (P_s) -.6" H_2O
FILTER NUMBER (s) —
MINIMUM SAMPLE VOLUME ≈ 120 ft³
INITIAL LEAK CHECK on Back of 1st Page (.010" at 15" Hg)

PROBE LENGTH AND TYPE 5' Glass
NOZZLE I.D. .250
ASSUMED MOISTURE, % 25%
SAMPLE BOX NUMBER –
METER BOX NUMBER 4
METER Δ H@ 1.78
C FACTOR .70
PROBE HEATER SETTING 80%
HEATER BOX SETTING 250°F
REFERENCE Δp .95
DRY/GAS METER FACTOR (Y) 1.0092
FINAL LEAK CHECK (.012 at 10" Hg)

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

1910 * 10 sec

Traverse Point Number	180 Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Orifice Pressure Differential (ΔH, in. H_2O) Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
		1903	741.743													
D-1	185	08	743.44	.17	297	.31	.31	N/A	251	N/A	N/A	56	80	75	70	4
	190	13	745.58	.38	322	.72	.72	N/A	247	N/A	N/A	59	83	74	72	6
D-2	195	18	747.42	.25	320	.46	.46	N/A	251	N/A	N/A	58	85	74	62	5
	200	23	749.53	.38	326	.72	.72	N/A	254	N/A	N/A	57	86	76	65	6
D-3	205	28	751.54	.30	322	.56	.56	N/A	254	N/A	N/A	58	85	74	73	6
	210	33	753.41	.33	322	.63	.63	N/A	254	N/A	N/A	59	85	74	59	6
D-4	215	38	755.37	.35	323	.66	.66	N/A	253	N/A	N/A	59	86	74	54	6
	220	43	757.35	.35	321	.66	.66	N/A	253	N/A	N/A	60	86	75	53	5
D-5	225	48	759.31	.35	319	.66	.66	N/A	255	N/A	N/A	62	87	82	54	5
	230	53	761.29	.35	318	.66	.66	N/A	256	N/A	N/A	57	87	75	54	5
D-6	235	58	763.29	.35	318	.66	.66	N/A	258	N/A	N/A	58	86	75	60	5
	240	2003	765.520	.35	318	.66	.66	N/A	260	N/A	N/A	59	86	75	56	5
				END OF TEST #1												

COMMENTS 2 of 2

- Sample [illegible]

FIELD DATA

LEAK CHECKS @ 15" Hg
PRE POST
.010 .003
.005 .005
.007 .008
0.005 0.008

PLANT Site 05
DATE 2-27-85
SAMPLING LOCATION outlet
SAMPLE TYPE MM5
RUN NUMBER 05-MM5-Outlet 2 ⑤
OPERATOR Henry, Garcia
AMBIENT TEMPERATURE 78°F
BAROMETRIC PRESSURE 30.20
STATIC PRESSURE (P_s) -.6" H2O
FILTER NUMBER (s) —
MINIMUM SAMPLE VOLUME 120 ft³

MM5
1 of 2

PROBE LENGTH AND TYPE 5' Glass
NOZZLE I.D. ~~.250~~ .308
ASSUMED MOISTURE, % 25
SAMPLE BOX NUMBER —
METER BOX NUMBER 4
METER Δ H@ 1.78
C FACTOR .75
PROBE HEATER SETTING 250°F
HEATER BOX SETTING 250°F
REFERENCE Δp ~~.55~~ .40
DRY/GAS METER FACTOR (Y) 1.0052

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

	Traverse Point Number	Sampling Time Min. 0	1300 Clock Time (24-hr Clock)	768.076 Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H₂O	Stack T_s, in °F	Orifice Pressure Differential (ΔH, in. H₂O) Desired	Orifice Pressure Differential (ΔH, in. H₂O) Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
	A-1	5	05	771.08	.32	240	1.45	1.45	N/A	260	N/A	N/A	56	86	78	64	6
		10	10	774.24	.35	236	1.60	1.60	N/A	241	N/A	N/A	52	94	80	66	6
1311 * 15 sec	A-2	15	15	778.74	.75	241	3.4	3.4	N/A	234	N/A	N/A	49	99	81	74	10
		20	20	782.80	.60	317	2.8	2.8	N/A	240	N/A	N/A	51	101	82	75	10
	A-3	25	25	787.28	.70	319	3.2	3.2	N/A	244	N/A	N/A	52	103	83	76	10
		30	30	791.82	.70	319	3.2	3.2	N/A	247	N/A	N/A	51	104	83	74	10
	A-4	35	35	796.65	.70	317	3.2	3.2	N/A	252	N/A	N/A	51	104	94	77	10
		40	40	800.90	.70	319	3.2	3.2	N/A	256	N/A	N/A	52	105	85	77	10
1344 * 15 sec	A-5	45	45	805.50	.65	320	2.9	2.9	N/A	257	N/A	N/A	52	107	86	76	10
		50	50	809.80	.60	318	2.8	2.8	N/A	262	N/A	N/A	52	107	87	74	10
	A-6	55	55	813.83	.50	318	2.3	2.3	N/A	266	N/A	N/A	51	107	87	77	10
STOP		60	1400	817.953	.50	314	2.3	2.3	N/A	269	N/A	N/A	51	107	88	73	10
START		60	1412	818.485	← CHANGED to PORT					B							→
411 *	B-1	~~70~~ 65	17	822.91	.45	314	2.05	2.05	N/A	255	N/A	N/A	53	94	87	71	10
		70	22	826.06	.45	317	2.05	2.05	N/A	239	N/A	N/A	50	103	88	72	9

COMMENTS

	Traverse Point Number	70 Sampling Time Min.	1422 Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H₂O	Stack T, in °F	Orifice Pressure Differential (ΔH, in. H₂O)		Temperature °F/°C (Circle One)								
							Desired	Actual	Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
	B-2	75	27	830.00	.56	318	2.3	2.3	N/A	245	N/A	N/A	52	103	98	72	9
		80	32	833.98	.50	318	2.3	2.3	N/A	243	N/A	N/A	53	103	88	75	9
	B-3	85	37	838.08	.50	318	23	2.3	N/A	244	N/A	N/A	54	104	58	74	9
		90	42	841.68	.40	316	1.85	1.85	N/A	249	N/A	N/A	54	103	89	73	8
1441 *	B-4	95	47	845.47	.50	318	2.3	23	N/A	263	N/A	N/A	54	103	88	71	9
15 sec		100	52	849.31	.45	317	2.05	2.05	N/A	260	N/A	N/A	54	103	89	72	8
	B-5	105	57	853.78	.40	316	1.85	1.85	N/A	261	N/A	N/A	55	103	89	73	8
		110	1502	856.54	.40	314	1.85	1.85	N/A	260	N/A	N/A	54	104	87	72	8
	B-6	115	07	859.82	.30	317	1.35	1.35	N/A	263	N/A	N/A	54	104	89	72	7
1510 * STOP		120	12	863.223	.30	313	1.35	1.35	N/A	274	N/A	N/A	52	103	89	72	7
15 sec START		120	1527	864.623	← CHANGED to Port C ——→												
	C-1	125	32	866.42	.07	238	.33	.33	N/A	256	N/A	N/A	62	84	87	76	4
		130	37	867.92	.07	265	.33	.33	N/A	247	N/A	N/A	60	92	57	65	4
	C-2	135	42	869.81	.10	311	.47	.47	N/A	246	N/A	N/A	56	91	58	63	5
1544 *		140	47	871.85	.12	311	.51	.51	N/A	251	N/A	N/A	55	91	86	64	5
15 sec	C-3	145	52	874.85	.12	314	.51	.51	N/A	251	N/A	N/A	56	91	85	65	5
		150	57	875.57	.12	314	.51	.51	N/A	252	N/A	N/A	55	90	85	65	5
	C-4	155	1602	877.55	.15	314	.70	.70	N/A	255	N/A	N/A	54	91	84	65	5
		160	07	879.61	.15	315	.70	.70	N/A	255	N/A	N/A	52	92	85	65	5
1611 *	C-5	165	12	881.68	.15	316	.70	.70	N/A	258	N/A	N/A	52	92	86	65	5
15 sec		170	17	883.74	.15	315	.70	.70	N/A	260	N/A	N/A	53	92	84	65	5
	C-6	175	22	885.98	.17	314	.79	.79	N/A	264	N/A	N/A	52	93	85	64	5
STOP		180	27	888.440	.17	317	79	.79	N/A	268	N/A	N/A	52	95	86	64	5
START		[illegible]		[illegible]	← CHANGED to Port D ——→												
	TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
	AVERAGE	●	●	●	●		●		●	●	●	●	●			●	●

* Stack whistled AND Flows INCREASE for 15 sec.

FIELD DATA

MMS

2 of 2

PLANT Site 05
DATE 2-27-85
SAMPLING LOCATION outlet
SAMPLE TYPE MMS
RUN NUMBER 05-MMS-Outlet-2
OPERATOR HENRY/GARCIA
AMBIENT TEMPERATURE 75°F
BAROMETRIC PRESSURE 30.20
STATIC PRESSURE (P_s) −.6" H_2O
FILTER NUMBER (s) –
MINIMUM SAMPLE VOLUME 120 f^3

PROBE LENGTH AND TYPE 5' GLASS
NOZZLE I.D. ~~.250~~ .305
ASSUMED MOISTURE, % 25
SAMPLE BOX NUMBER –
METER BOX NUMBER 4
METER Δ H@ 1.78
C FACTOR .75
PROBE HEATER SETTING 250°F
HEATER BOX SETTING 250°F
REFERENCE Δp .40
DRY/GAS METER FACTOR (Y) .9924

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

	Traverse Point Number	180 Sampling Time Min.	1642 Clock Time (24-hr Clock)	892.285 Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F ①	Orifice Pressure Differential (ΔH, in. H_2O) Desired	Orifice Pressure Differential (ΔH, in. H_2O) Actual	Temperature °F/°C (Circle One) Probe	Filter Skin ②	Filter Out	Recirc. Water	Absorbent Trap ③	Dry Gas Meter Inlet (T_m in) ⑤	Dry Gas Meter Outlet (T_m out) ⑥	Impinger Exit ④	Pump Vacuum in. Hg	
1644 5 sec. *	D-1	185	47	894.76	.17	305	.79	.79	N/A	250	N/A	N/A	54	93	86	66	4	7
		190	52	897.45	.25	315	1.15	1.15	N/A	244	N/A	N/A	52	96	86	51	7	
	D-2	195	57	900.30	.25	316	1.15	1.15	N/A	245	N/A	N/A	52	98	86	65	7	
		200	1702	903.14	.25	315	1.15	1.15	N/A	245	N/A	N/A	53	99	86	64	7	4.0
	D-3	205	07	906.12	.30	318	1.35	1.35	N/A	243	N/A	N/A	53	100	86	65	7	4
1710 5 Sec *		210	12	908.95	.25	317	1.15	1.15	N/A	242	N/A	N/A	53	100	86	65	7	
	D-4	215	17	912.15	.35	316	1.6	1.6	N/A	245	N/A	N/A	55	99	86	65	7	
		220	22	915.22	.30	318	1.35	1.35	N/A	247	N/A	N/A	55	101	86	66	7	
	D-5	225	27	918.41	.35	316	1.6	1.6	N/A	253	N/A	N/A	56	100	86	67	7	1
		230	32	921.40	0.30	316	1.35	1.35	N/A	252	N/A	N/A	55	98	86	66	7	6
	D-6	235	37	924.30	0.31	317	1.4	1.4	N/A	253	N/A	N/A	50	95	84	66	7	
		240	42	927.38	0.33	314	1.5	1.5	N/A	262	N/A	N/A	54	95	84	67	7	8
STOP				END	OF	TEST												

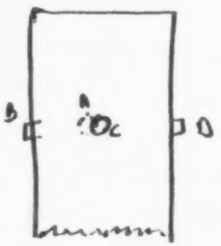
COMMENTS * Stack whstled + ~~Flow~~ ΔP INCREASED

LEAK CHECKS	PRE	POST
1	.015	.007
	.007	.010
	.011	.010
	.015	.015

FIELD DATA

MM5

PLANT Site 05
DATE 2-28-85
SAMPLING LOCATION outlet
SAMPLE TYPE MMS
RUN NUMBER 05-MMS-outlet 3
OPERATOR HENRY GARCIA
AMBIENT TEMPERATURE 65°F
BAROMETRIC PRESSURE 30.22
STATIC PRESSURE (P_s) −.6" H2O
FILTER NUMBER (s) — N/A
MINIMUM SAMPLE VOLUME 120 f³



SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

PROBE LENGTH AND TYPE 5' Glass
NOZZLE I.D. .308
ASSUMED MOISTURE, % 25
SAMPLE BOX NUMBER 4
METER BOX NUMBER 4
METER ΔH@ 1.78
C FACTOR .75
PROBE HEATER SETTING 75%
HEATER BOX SETTING 250°F
REFERENCE Δp .40
DRY/GAS METER FACTOR (Y) 1.0052

	Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Oriface Pressure Differential (ΔH, in. H_2O)		Temperature °F/°C (Circle One)								Pump Vacuum in. Hg
							Desired	Actual	Probe	Filter		Recirc. Water	Absorbent Trap	Dry Gas Meter		Impinger Exit	
										Skin	Out			Inlet (T_m in)	Outlet (T_m out)		
		0	1059	928.173													
	A-1	5	1104	932.70	.60	318	2.7	2.7	N/A	242	N/A	N/A	57	92	80	65	8
		10	09	935.35	.40	315	1.85	1.85	N/A	227	N/A	N/A	50	102	82	63	8
1110 * 15 sec	A-2	15	14	939.38	.60	320	2.7	2.7	N/A	234	N/A	N/A	53	108	85	67	8
		20	19	943.86	.60	319	2.7	2.7	N/A	243	N/A	N/A	52	110	86	69	8
	A 3	25	24	949.68	.70	322	3.2	3.2	N/A	244	N/A	N/A	53	114	89	73	11
		30	29	952.38	.65	323	2.5	2.5	N/A	250	N/A	N/A	54	114	90	68	9.5
	A-4	35	34	956.93	.70	323	3.2	3.2	N/A	250	N/A	N/A	54	114	90	68	10.5
		40	39	961.44	.70	323	3.2	3.2	N/A	252	N/A	N/A	53	115	90	65	11
	A-5	45	44	966.07	.63	323	2.85	2.85	N/A	252	N/A	N/A	54	115	92	70	10
1144 * 15 sec		50	49	970.55	.63	321	2.85	2.85	N/A	256	N/A	N/A	53	115	91	66	9
	A-6	55	54	974.49	.48	324	2.2	2.2	N/A	261	N/A	N/A	55	112	91	70	8
STOP		60	59	978.520	.48	324	2.2	2.2	N/A	264	N/A	N/A	56	112	92	65	8
START			1235	979.995	← CHANGED	to	Port		B →								
	B-1	65	40	983.55	.50	319	2.3	2.3	N/A	218	N/A	N/A	48	88	79	66	10
1244 * 15 sec.		70	45	987.61	.53	320	2.4	2.4	N/A	224	N/A	N/A	47	98	80	70	9

COMMENTS * STACK whistled + Velocity INCREASED

RUN-2

Hot Bag, 247

Traverse Point Number	70 Sampling Time Min.	1245 Clock Time (24-hr Clock)	987.61 Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Oriface Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
B-2	75	50	991.43	.48	318	2.2	2.2	N/A	232	N/A	N/A	50	101	80	70	9
	80	55	995.27	.48	320	2.2	2.2	N/A	240	N/A	N/A	53	104	82	68	9
B-3	85	1300	999.46	.60	320	2.7	2.7	N/A	243	N/A	N/A	53	106	83	69	10
	90	05	1003.59	.63	321	2.85	2.85	N/A	247	N/A	N/A	54	109	85	65	10
B-4	95	10	1007.79	.55	320	2.5	2.5	N/A	249	N/A	N/A	54	107	85	69	10
	100	15	1011.94	.55	320	2.5	2.5	N/A	252	N/A	N/A	55	109	85	70	10
B-5	105	20	1015.98	.48	321	2.2	2.2	N/A	257	N/A	N/A	56	112	87	69	10
	110	25	1020.14	.42	320	1.95	1.95	N/A	260	N/A	N/A	56	111	87	72	9
B-6	115	30	1023.40	.42	321	1.95	1.95	N/A	264	N/A	N/A	58	112	89	69	9
	120	35	1026.646	.30	321	1.4	1.4	N/A	265	N/A	N/A	56	106	89	63	9
	120	1346	1026.906	CHANGED			TO	PORT	C							
C-1	125	51	1029.10	.10	316	.47	.47	N/A	260	N/A	N/A	61	81	81	70	5
	130	56	1030.77	.10	316	.47	.47	N/A	245	N/A	N/A	58	84	80	67	5
C-2	135	1401	1032.78	.10	317	.47	.47	N/A	243	N/A	N/A	57	85	79	66	5
	140	06	1034.42	.10	315	.47	.47	N/A	264	N/A	N/A	57	86	78	66	5
C-3	145	11	1036.44	.13	318	.61	.61	N/A	294	N/A	N/A	56	87	82	66	5
	150	16	1038.54	.15	317	.70	.70	N/A	245	N/A	N/A	56	87	75	63	5
C-4	155	21	1040.62	.15	317	.70	.70	N/A	251	N/A	N/A	55	84	81	64	5
	160	26	1042.61	.14	318	.65	.65	N/A	254	N/A	N/A	55	83	76	62	5
C-5	165	31	1045.14	.18	317	.84	.84	N/A	256	N/A	N/A	55	81	78	61	6
	170	36	1047.51	.18	319	.84	.84	N/A	262	N/A	N/A	55	82	73	62	6
C-6	175	41	1049.56	.18	315	.84	.84	N/A	256	N/A	N/A	55	83	73	62	6
	180	46	1051.913	.20	318	.93	.93	N/A	251	N/A	N/A	55	81	72	63	6
TOTAL		●		●	●	●	●	●	●	●	●	●	●	●	●	●
AVERAGE	●	●	●	●		●		●	●	●	●	●	●		●	●

1310 ✱ 15 sec.

Stop

Start

1410 ✱ 15 Sec

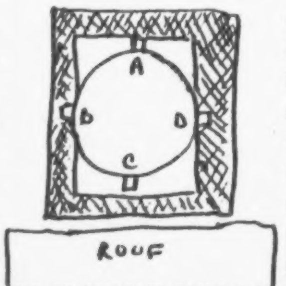
1444 ✱ 15 sec

1 of 2

FIELD DATA

2 of 2

PLANT Site 05
DATE 2-28-85
SAMPLING LOCATION Outlet
SAMPLE TYPE mms
RUN NUMBER 05-mms-outlet 3
OPERATOR Haney, Garcia
AMBIENT TEMPERATURE 65°F
BAROMETRIC PRESSURE
STATIC PRESSURE (P_s) -.6" H₂O
FILTER NUMBER (s) N/A
MINIMUM SAMPLE VOLUME 120 ft³



SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 5 MINUTES

PROBE LENGTH AND TYPE 5' GLASS
NOZZLE I.D. .308
ASSUMED MOISTURE, % 25
SAMPLE BOX NUMBER –
METER BOX NUMBER 4
METER Δ H@ 1.78
C FACTOR .75
PROBE HEATER SETTING 80%
HEATER BOX SETTING 250°F
REFERENCE Δp .40
DRY/GAS METER FACTOR (Y) 1.0092

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H₂O	Stack T_s, in °F	Orifice Pressure Differential (ΔH, in. H₂O) Desired	Orifice Pressure Differential (ΔH, in. H₂O) Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
	180	1453	1052.16													
D-1	185	58	1055.05	.26	313	1.2	1.2	N/A	231	N/A	N/A	56	74	70	62	7
	190	1503	1057.80	.26	317	1.2	1.2	N/A	231	N/A	N/A	55	82	70	62	7
D-2	195	08	1060.61	.24	317	1.1	1.1	N/A	228	N/A	N/A	55	81	70	62	7
	200	13	1063.26	.24	317	1.1	1.1	N/A	235	N/A	N/A	56	82	70	61	7
D-3	205	18	1065.73	.27	315	1.25	1.25	N/A	234	N/A	N/A	56	82	69	63	7
	210	23	1068.78	.32	317	1.5	1.5	N/A	234	N/A	N/A	56	80	69	62	7
D-4	215	28	1071.74	.32	316	1.5	1.5	N/A	231	N/A	N/A	57	81	69	61	7
	220	33	1074.78	.32	316	1.5	1.5	N/A	230	N/A	N/A	57	80	69	61	7
D-5	225	38	1078.02	.37	314	1.8	1.8	N/A	234	N/A	N/A	59	81	68	62	8
	230	43	1081.29	.37	315	1.8	1.8	N/A	237	N/A	N/A	59	83	69	62	8
D-6	235	48	1084.6	.37	314	1.8	1.8	N/A	242	N/A	N/A	60	83	69	64	8
	240	53	1087.942	.37	316	1.8	1.8	N/A	243	N/A	N/A	60	83	69	66	8
			END of TEST ③													

COMMENTS

MODIFIED METHOD 5 DATA

HCl

PLANT BPP
DATE 2/26/85
SAMPLING LOCATION ESP outlet
SAMPLE TYPE HCl
RUN NUMBER #1
OPERATOR Alg
AMBIENT TEMPERATURE 82
BAROMETRIC PRESSURE
STATIC PRESSURE (P_s) -.6
FILTER NUMBER (s) HCl-1
MINIMUM SAMPLE VOLUME
INITIAL LEAK CHECK .017

PROBE LENGTH AND TYPE 3' glass
NOZZLE I.D. 0.247
ASSUMED MOISTURE, % 25
SAMPLE BOX NUMBER HCl-1
METER BOX NUMBER 6
METER Δ H@ 1.79
C FACTOR 0.70
PROBE HEATER SETTING 250° F
HEATER BOX SETTING 250° F
REFERENCE Δp 0.95
DRY/GAS METER FACTOR (Y) .9924
FINAL LEAK CHECK 0.019 @ 10 in Hg

First Bag
Bag start 14:54
Bag stop ~~16:15~~ 15:39

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 10 MINUTES

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Orifice Pressure Differential (ΔH, in. H_2O)		Temperature °F/°C (Circle One)								Pump Vacuum in. Hg
						Desired	Actual	Probe	Filter		Recirc. Water	Absorbent Trap	Dry Gas Meter		Impinger Exit °F	
									Skin °F	Out			Inlet (T_m in) °F	Outlet (T_m out) °F		
	0	1448	629.706 ~~628.336~~													
	10	58	634.430	.25	318	.47	.47		256				107	99	80	0
	20	1508	637.870	.30	319	.55	.55		264				102	101	65	0
	30	15:18	641.90	.25	316	.47	.47		249				102	101	67	0
	40	15:28	646.11	.28	315	.52	.52		229				102	99	68	0
	50	15:38	649.99	0.24	314	0.45	0.45		261				100	94	67	0
	60	15:48	653.78	0.24	313	0.45	0.45		259				99	90	66	0
	70	15:58	657.80	0.28	313	0.52	0.52		257				96	88	67	0
	80	16:08	661.66	0.26	312	0.48	0.48		258				96	88	69	0
	90	16:18	665.52	0.25	310	0.47	0.47		256				95	87	70	0
	100	16:28	669.50	0.26	310	0.52	0.52		257				95	86	66	0
	110	16:38	673.47	0.28	311	0.52	0.52		254				94	86	67	0
	120	16.48	677.31	0.25	313	0.47	0.47		256				94	85	68	0
				END OF TEST												

COMMENTS stack whistled at 15:45 and 16.44

STOP.

FIELD DATA

HCL

PLANT Site 05
DATE 2-27-85
SAMPLING LOCATION outlet
SAMPLE TYPE ~~[illegible]~~ HCL
RUN NUMBER 05-HCL-outlet-2
OPERATOR HENRY GARCIA
AMBIENT TEMPERATURE 78°F
BAROMETRIC PRESSURE 30.20
STATIC PRESSURE (P_s) − 6" H_2O
FILTER NUMBER (s) —
MINIMUM SAMPLE VOLUME ~~120~~ ft³

PROBE LENGTH AND TYPE 4' GLASS
NOZZLE I.D. .247
ASSUMED MOISTURE, % 25%
SAMPLE BOX NUMBER —
METER BOX NUMBER 6
METER Δ H@ 1.794
C FACTOR .70
PROBE HEATER SETTING 250
HEATER BOX SETTING 250
REFERENCE Δp ~~.85~~ .40
DRY/GAS METER FACTOR (Y) .9924

Int. LK Check .010
Final LK Check .020

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 10 MINUTES

Port C Traverse Point Number	~~Heb~~ O Sampling Time Min.	1306 ~~1305~~ Clock Time (24-hr Clock)	679.~~[illegible]~~ 442 Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Oriface Pressure Differential (ΔH, in. H_2O) Desired	Actual	Temperature °F/°C (Circle One) Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
C-3	10	1316	683.9	.33	314	.63	.63		240				78	76	55	0
	20	26	688.2	.33	314	.63	.63		259				84	77	57	1
	30	36	692.7	.33	315	.63	.63		261				86	78	59	1
	40	46	[illegible]	.32	316	.61	.61		261				87	78	61	1
	50	56	701.6	.33	315	.63	.63		259				88	79	63	1
	60	1406	706.51	.34	313	.64	.64		255				87	77	62	1
	70	16	710.67	.34	312	.64	.64		262				89	79	64	1
	80	26	714.74	.30	314	.56	.56		261				88	80	67	1
	90	36	718.94	.30	313	.56	.56		256				87	80	69	1
[illegible]	100	46	723.28	.34	313	.64	.64		258				87	80	71	1
	10	56	727.85	.34	313	.64	.64		261				84	80	62	1
	20	1500	732.476	.34	312	.64	.64		263				89	81	62	1

COMMENTS

FIELD DATA

HCL

PLANT Site 05
DATE 3-28-85
SAMPLING LOCATION outlet
SAMPLE TYPE HCL
RUN NUMBER 05-HCL-outlet-3
OPERATOR HENRY, GARCIA
AMBIENT TEMPERATURE 65°F
BAROMETRIC PRESSURE
STATIC PRESSURE (P_s) -6" H2O
FILTER NUMBER (s) -
MINIMUM SAMPLE VOLUME ~~120~~ f -

PROBE LENGTH AND TYPE 4' GLASS
NOZZLE I.D. .247
ASSUMED MOISTURE, % 25
SAMPLE BOX NUMBER -
METER BOX NUMBER 6
METER Δ H@ 1.794
C FACTOR .70
PROBE HEATER SETTING 80%
HEATER BOX SETTING 250°F
REFERENCE Δp .95
DRY/GAS METER FACTOR (Y) .9924

Initial Leak Check .007
Final .015

SCHEMATIC OF TRAVERSE POINT LAYOUT
READ AND RECORD ALL DATA EVERY 10 MINUTES

Traverse Point Number	Sampling Time Min.	Clock Time (24-hr Clock)	Gas Meter Reading (V_m), ft³	Velocity Head (ΔP_s), in. H_2O	Stack T_s, in °F	Orifice Pressure Differential (ΔH, in. H_2O)		Temperature °F/°C (Circle One)								
						Desired	Actual	Probe	Filter Skin	Filter Out	Recirc. Water	Absorbent Trap	Dry Gas Meter Inlet (T_m in)	Dry Gas Meter Outlet (T_m out)	Impinger Exit	Pump Vacuum in. Hg
Port D	0	953	734.905													
	10	1003	739.27	.32	313	.61	.61		235				80	75	62	0
	20	13	743.93	.34	314	.66	.66		265				87	77	54	0
	30	23	748.39	.34	313	.66	.66		272				92	79	56	0
	40	33	752.63	.30	315	.58	.58		270				90	79	57	0
	50	43	756.84	.30	318	.58	.58		272				90	81	57	0
	60	53	761.02	.30	317	.58	.58		269				89	80	55	0
	70	1103	765.31	.30	315	.58	.58		270				81	77	56	0
	80	13	769.6	30 [illegible]	315	.58	.58		270				97	84	55	0
	90	23	773.84	.30	315	.58	.58		273				98	87	48	0
	100	33	778.17	.30	316	.58	.58		254				99	87	46	0
	110	43	782.46	.30	318	.58	.58		256				101	88	48	0
	120	53	787.128	.28	318	.64	.64		255				101	89	49	0

1010 15 sec ✱

1044 15 sec ✱

COMMENTS

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT 05

DATE 2·26·85

SAMPLING LOCATION Inlet

SAMPLE TYPE MM5

RUN NUMBER 05·MM5-D-01

SAMPLE BOX NUMBER

CLEAN-UP PERSON D. Savia

SOLVENT RINSES H_2O $MECl_2$ · Aceton

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # 2	FINAL: ______ mg	
		TARE: ______ mg	
		NET: ______ mg	______ µg
FILTER NUMBER N/A ______	CONTAINER # 1	FINAL: ______ mg	
______ ______		TARE: ______ mg	
______ ______		NET: ______ mg	______ µg
		FRONT HALF SUBTOTAL ______ mg	______ µg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # DSS [illegible] 3		______ µg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # #5 ac3.1		______ µg
IMPINGER NO.1 (QA)	CONTAINER #4 ______	NET GAIN ______ (See Impinger Results Reverse Side)	______ µg
			TOTAL ______ µg

NOTES/OBSERVATIONS:

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. 05-MMS-01Ⓓ-Inlet Date 2-26-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration	Weight (grams)
1*	None	—	Knock-Out	Final 1287.8 Initial 471.4 Wt. gain 816.4
2	HPLC-H_2O	100	Straight	Final 667.2 Initial 606.8 Wt. gain 50.4
3	HPLC-H_2O	100	Straight	Final 498.3 Initial 555.7 Wt. gain - 57.4
4	None	—	Straight	Final 488.2 Initial 488.2 Wt. gain
5	Silica Gel	200g	Straight	Final 753.1 Initial 728.3 Wt. gain 24.8
6			Trap #5	Final 212.5 Initial 208.1 Wt. gain 4.4
7				Final Initial Wt. gain

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 837.4

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT OS

DATE 2-27-85

SAMPLING LOCATION Inlet

SAMPLE TYPE MMS

RUN NUMBER 05-MM5-D-02

SAMPLE BOX NUMBER ______

CLEAN-UP PERSON D. Savig

SOLVENT RINSES H2O - Acetone - MECL2

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER # ______	FINAL: ______ mg	
		TARE: ______ mg	
		NET: ______ mg	______ µg
FILTER NUMBER ______ ______ ______ ______ ______ ______	CONTAINER # ______	FINAL: ______ mg	
		TARE: ______ mg	
		NET: ______ mg	______ µg
		FRONT HALF SUBTOTAL ______ mg	______ µg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER # ______		______ µg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # 1		______ µg
IMPINGER NO. 1 (QA)	CONTAINER #4 ______	NET GAIN ______ (See Impinger Results Reverse Side)	______ µg
			TOTAL ______ µg

NOTES/OBSERVATIONS:

A

ORGANIC SAMPLING TRAIN IMPINGER RECOVERY SHEET

Sample Code Ident. 05-MMS-D-02 Date 2-27-85

Impinger No.	Solution Used	Amount of Solution (ml)	Imp. Tip Configuration		Weight (grams) 1	2
1*	None	—	Knock-Out	Final	906.1	963.2
				Initial	457.6	397.8
				Wt. gain	448.5	565.4
2	HPLC H_2O	100	Straight	Final	631.7	
				Initial	629.5	
				Wt. gain	2.2	
3	HPLC H_2O	100	"	Final	629.8	
				Initial	627.0	
				Wt. gain	2.8	
4	None	—	"	Final	508.6	
				Initial	503.0	
				Wt. gain	5.6	
5	Silica Gel	200 G	"	Final	752.1 *	
				Initial	721.3	
				Wt. gain	30.8	
6			Trap #1	Final	209.7	
				Initial	206.0	
				Wt. gain	3.7	
7				Final		
				Initial		
				Wt. gain		

TOTAL WEIGHT GAIN OF IMPINGERS (grams) 1055.3-[illegible]

* 758.2 with tape on bottom to raise little

*QA SAMPLE FOR ORGANIC COLLECTION EFFICIENCY - SAVE IN CONTAINER #4.

Samples for Further Analysis:

Sample No.	Description	Species	Results (Total mg.)

ORGANIC SAMPLING TRAIN RECOVERY SHEET

PLANT 05-[redacted]

DATE 2-28-85

SAMPLING LOCATION Inlet

SAMPLE TYPE MMS

RUN NUMBER 05-MMS-D-03

SAMPLE BOX NUMBER

CLEAN-UP PERSON D. Savia

SOLVENT RINSES H_2O Acetone $MECl_2$

COMMENTS:

		GRAVIMETRIC RESULTS	LABORATORY RESULTS
FRONT HALF - PARTICULATE PHASE			
SOLVENT WASH OF NOZZLE, PROBE, CYCLONE (BYPASS), FLASK, FRONT HALF OF FILTER HOLDER	CONTAINER #	FINAL: mg	
		TARE: mg	
		NET: mg	μg
FILTER NUMBER	CONTAINER #	FINAL: mg	
		TARE: mg	
		NET: mg	μg
		FRONT HALF SUBTOTAL mg	μg
ORGANIC-VAPOR PHASE			
TRANSFER LINE AND CONDENSER (SOLVENT RINSE)	CONTAINER #		μg
RESIN TRAP (XAD-2) (NOTE): CAP & LABEL IMMEDIATELY	TRAP # 10		μg
IMPINGER NO.1 (QA)	CONTAINER #4	NET GAIN (See Impinger Results Reverse Side)	μg
			TOTAL μg

NOTES/OBSERVATIONS:

APPENDIX J

PROJECT PARTICIPANTS

APPENDIX J

PROJECT PARTICIPANTS

Name	Organization	Responsibility
Mike Palazzolo	Radian Corporation	Field Engineer
Bob Jongleux	"	Field Crew Lead
Dave Dayton	"	CEM Operator
Dave Savia	"	Sample Recovery
Jim McReynolds	"	ESP Inlet Location
Winton Kelly	"	ESP Inlet Location
Carol Jamgochian	"	ESP Inlet Location
Gary Henry	"	ESP Outlet Location
Lee Garcia	"	ESP Outlet Location
Robert Mournighan	EPA-HWERL-Cincinnati	Observer
Richard Crume	Research Triangle Institute,	Field Audit
Donna Holder	Research Triangle Institute,	Field Audit

APPENDIX K

VOLUMETRIC FLOWRATE:
BLOCKED DUCT CORRECTIONS

RADIAN
CORPORATION

CALCULATION SHEET

CALC. NO. ____

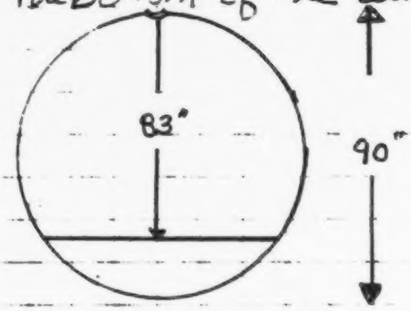
SIGNATURE ____ DATE ____ CHECKED ____ DATE ____

PROJECT ____ JOB NO. ____

SUBJECT Area Correction for Inlet duct SHEET ____ OF ____ SHEETS

A horizontal duct with the port on top which required a vertical probe.

The diameter was measured at 83"; sediment in the bottom of the duct has reduced the diameter from 90".



The reduced area of the duct was calculated with the following equation:

$$\frac{\pi R^2}{2} - R^2\cos^{-1}\frac{d}{R} - d\sqrt{R^2-d^2}$$

Where R: 45" and d = 38"

The corrected area = 6133.0 inches square

APPENDIX L

ERROR ANALYSIS OF CONTROL DEVICE EFFICIENCY CALCULATIONS

APPENDIX L
ERROR ANALYSIS: CONTROL DEVICE EFFICIENCY CALCULATIONS

Objective: Given the analytical uncertainty of the dioxin/furan analyses (± 50% accuracy), estimate the uncertainty of the control device efficiency calculations.

Let: $C_{out,meas}$ = the measured concentration of a given dioxin/furan homologue at the outlet location.

$C_{in,meas}$ = the measured concentration of a given dioxin/furan homologue at the inlet location.

$C_{out,max}$ = the maximum possible concentration of the dioxin/furan homologue given the measured value $C_{out,meas}$.

$C_{out,min}$ = the minimum possible concentration of the dioxin/furan homologue given the measured value $C_{out,meas}$.

$C_{in,max}$ = the maximum possible concentration of the dioxin/furan homologue, given the measured value $C_{in,meas}$.

$C_{in,min}$ = the minimum possible concentration of the dioxin/furan homologue, given the measured value $C_{in,meas}$.

E = the removal efficiency of the control device

Assuming ± 50 percent analytical accuracy:

$$C_{min} = C_{meas} - 0.5\ C_{meas} = 0.5\ C_{meas}$$

$$C_{max} = C_{meas} + 0.5\ C_{meas} = 1.5\ C_{meas}$$

Note that:

$$E_{max} = \frac{C_{in,max} - C_{out,min}}{C_{in,max}} = 1 - \frac{C_{out,min}}{C_{in,max}}$$

$$E_{max} = 1 - \frac{0.5\ C_{out,meas}}{1.5\ C_{in,meas}} = 1 - {}^{1}/_{3}\ (1 - E_{meas})$$

$$= {}^{2}/_{3} + {}^{1}/_{3}\ E_{meas}$$

and:

$$E_{min} = \frac{C_{in,min} - C_{out,max}}{C_{in,min}} = 1 - \frac{C_{out,max}}{C_{in,min}}$$

$$= 1 - \frac{1.5\ C_{out,meas}}{0.5\ C_{in,meas}}$$

$$= 1 - 3\ (1 - E_{meas})$$

$$E_{min} = 3\ E_{meas} - 2$$

Now, $E_{min} > 0$ positive control (i.e., emissions reduction across the control device)

$$(3E_{meas} - 2) > 0$$

$$E_{meas} > {}^{2}/_{3}$$

Therefore, if E_{meas} is larger than 66.7 percent, the true removal efficiency can safely be assumed to be greater than zero.

And, $E_{max} < 0$ negative control (i.e., emissions increase across the control device)

$${}^{2}/_{3} + {}^{1}/_{3}\ E_{meas} < 0$$

$$E_{meas} < -2$$

Therefore, if E_{meas} is less than -200 percent, the true efficiency can safely be assumed to be less than zero.

To summarize:

$E_{meas} > 66.7$ percent	positive control
$-200 < E_{meas} < 66.7$ percent	no definitive conclusions can be drawn
$E_{meas} < 200$ percent	no negative control

TABLE L.1 VALUES OF E_{max} and E_{min} FOR VARIOUS MEASURED CONTROL EFFICIENCIES

Control Device Efficiency (%)		
E_{meas}	E_{max}	E_{min}
100	100	100
95	98.3	85
90	96.7	70
85	95.0	55
80	93.4	40
75	91.7	25
50	83.4	-50
25	75.0	-125
0	66.7	-200
-25	58.4	-275
-50	50.0	-350
-100	33.4	-500
-200	0	-800

$$E_{max} = (200 + E_{meas})/3$$

$$E_{min} = 3E_{meas} - 200$$

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

1. REPORT NO. EPA-450/4-84-014n	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE National Dioxin Study Tier 4 - Combustion Sources Final Test Report - Site 5 Black Liquor Boiler BLB - B		5. REPORT DATE April 1987 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Michael A. Palazzolo, Winton E. Kelly Donna Holder		8. PERFORMING ORGANIZATION REPORT NO. 87-222-109-02-21
9. PERFORMING ORGANIZATION NAME AND ADDRESS Radian Corporation Post Office Box 13000 Research Triangle Park, NC 27709		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO. 68-03-3148
12. SPONSORING AGENCY NAME AND ADDRESS U.S. Environmental Protection Agency, OAQPS Research Triangle Park, NC 27711 Office of Research and Development Washington, DC 20460		13. TYPE OF REPORT AND PERIOD COVERED Final 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES

EPA Project Officers: Donald Oberacker, ORD
William B. Kuykendal, OAQPS

16. ABSTRACT

This report summarizes the results of a dioxin/furan emissions test of a black liquor recovery boiler equipped with a dry-bottom electrostatic precipitator for particulate emissions control. Black liquor recovery boilers are used at Kraft pulp mills to produce process steam and to reclaim inorganic chemicals from spent wood pulping liquors. This test is the fifth in a series of several dioxin/furan emissions tests being conducted under Tier 4 of the National Dioxin Study. The primary objective of Tier 4 is to determine if various combustion sources are found to emit dioxin or furan, the secondary objective of Tier 4 is to quantify these emissions.

Black liquor recovery boilers are one of 8 combustion source categories that have been tested in the Tier 4 program. After an initial information screening and one-day pre-survey visit, this site (BLB-B) was selected partially because of the higher chloride content of the black liquor (3.5 wt.% dry) compared to other black liquor recovery boiler sites surveyed in the Tier 4 study (approx. 0.2 to 1.0 wt%, dry).

Data presented in the report include dioxin (tetra through octa homologue + 2378 TCDD) and furan (tetra through octa homologue + 2378 TCDF) results for stack samples. In addition, process data collected during sampling are also presented.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Air Emissions Combustion Sources Dioxin Furans 2,3,7,8 Tetrachlorodibenzo-p-dioxin Black Liquor Boiler Pulp and Paper	Air Pollution Emissions Data	
18. DISTRIBUTION STATEMENT Release Unlimited	19. SECURITY CLASS *(This Report)* Unclassified	21. NO. OF PAGES 3
	20. SECURITY CLASS *(This page)* Unclassified	22. PRICE